Ty Unnos Sitka Spruce Construction System

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dru-w
Design Research Unit Wales
COED CYMRU

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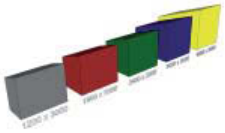
28.01.2009

'Ty Unnos'– 'the house of one night'- an integrated whole house system for low carbon affordable housing- is to be developed for commercial realisation. The project is a partnership between Coed Cymru and Design Research Unit Wales (DRU-w) at the Welsh School of Architecture. The Sitka Spruce Ty Unnos project aims to create an integrated whole house system which:

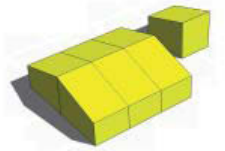
- is low cost
- adds value to a poor quality timber
- is highly sustainable
- results in high quality rural architecture

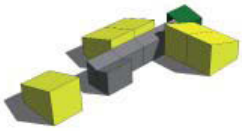
The Context

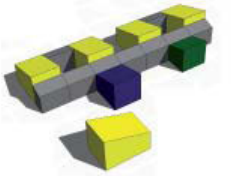
The increase in environmental assessment of construction materials and their sourcing is critical in achieving the UK's 2016 target, and Wales' 2011 target, for Zero Carbon housing. Furthermore, recent estimates record an unfulfilled demand of approximately 40,000 dwellings per annum in England and Wales, which is unlikely to be met through traditional house building techniques. Ty Unnos aims to use locally sourced, low value components to help fill this gap in the affordable, sustainable, rural housing market.

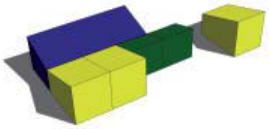


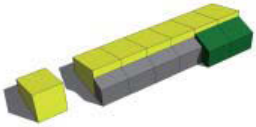
Wales has 150,000 hectares of coniferous plantations which produce around a million tonnes of softwood in the round per annum. Over 70% of current production is Sitka spruce, a native of the Pacific coast of North America which suits Wales' mild, wet climate and peaty upland soils. However, its tendency to twist during drying makes it unsuitable for use in construction; currently it is used for paletting, fencing and as low grade cacassing timber. While open panel timber frame is common in the UK, advanced forms of MMC, for example closed panels or volumetric units, are not well established, particularly in Wales. The majority of available timber frame systems are dependent on imported softwoods and manufactured boards and components, and do not use local timber crops. Ty Unnos will enable the UK to match some of the developments, notably in Alpine and Scandinavian regions, in the sensible modification and engineering of indigenous crops for high end use in sustainable offsite construction.











The Concept

Ty Unnos is inspired by Jorn Utzon's Espansiva system, a standardised additive system for low cost, low density rural housing, based on modules creating single storey homes. The monopitch Espansiva modules enable simple and varied spatial arrangements to be created with minimal structural intrusion into spaces. Modules are combined to create a wide variety of additive house types.

The Ty Unnos system is based on a series of modular rooms varying in sizes from 1.2m x 3m to 4.8m x 3m, or from entrance lobby to small bedroom to kitchen to living room. These are created from prefabricated box beams, using readily available lengths of Sitka Spruce, which stabilises the timber and prevents twisting. These beams form portal frames, which are infilled for floor, walls and roof using either SIPS panels or panels made up of Sitka Spruce ladder beams infilled with locally sourced sheep's wool or hemp insulation.

Developing the system

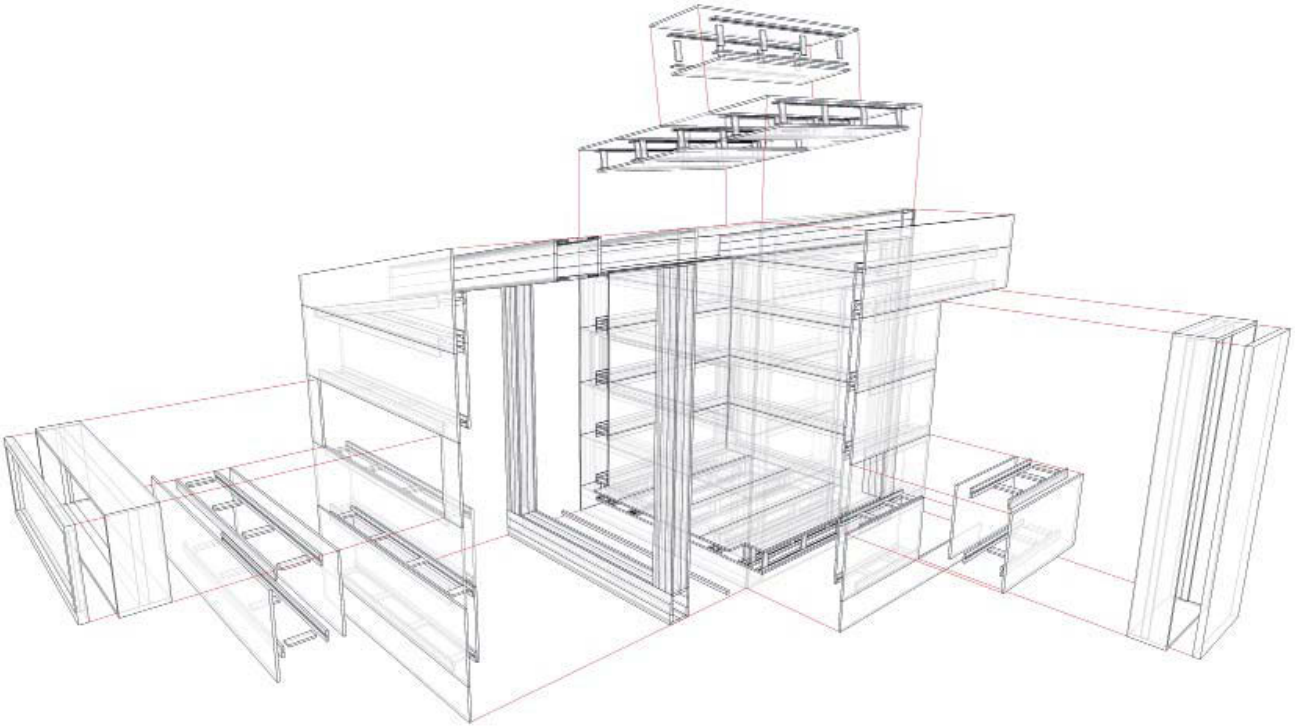
Initial testing of beams and frames has been carried out by Cowley timberwork and Burroughs. The system is now being developed with a view to certification for the mass market. As well as reducing the embodied energy of the building significantly the system is designed to meet Code 5/6 of Sustainable Homes through an integrated whole building envelope solution. The constructed envelope and its associated components will be developed to the equivalent of 'Passivhaus' standards applicable to the UK climate. Furthermore as the material is sourced from the local forest the system has potential to promote an ecologically sound approach to forest stewardship and to grow local sustainable business.

As conceived, the system potentially lends itself to two different but complementary technology platforms. The first avenue under exploration is using the system as frames and panels as described, while the second is working with a volumetric manufacturer to use Ty Unnos elements to create timber-framed whole room modules. Both will lead to MMC solutions with the majority of operations taking place off-site -the former in the factory with a rationalised, simplified assembly system which would lend itself to self-build in rural contexts, and the latter almost wholly in the factory.

Pilot Projects

The system is being tested, developed and refined through a series of real design projects which consider parameters such as economic and environmental performance and will enable the system to be certified. Initial interest in the Ty Unnos system has yielded a number of challenging projects, the first of which to gain planning approval is an Environmental Resource Classroom at Ebbw Vale for Blaenau Gwent County Borough Council, which combines Ty Unnos frames with SIPS panels and is expected to be complete by summer 2009.

A series of Ty Unnos pavilions are planned for summer 2009 at festivals across Wales and the South West to explore the possibilities of the system. The first housing pilot is to be carried out with Gwrp Gwalia, a pioneering Welsh RSL, in the next 18 months.



Project contacts:

Design Research Unit Wales
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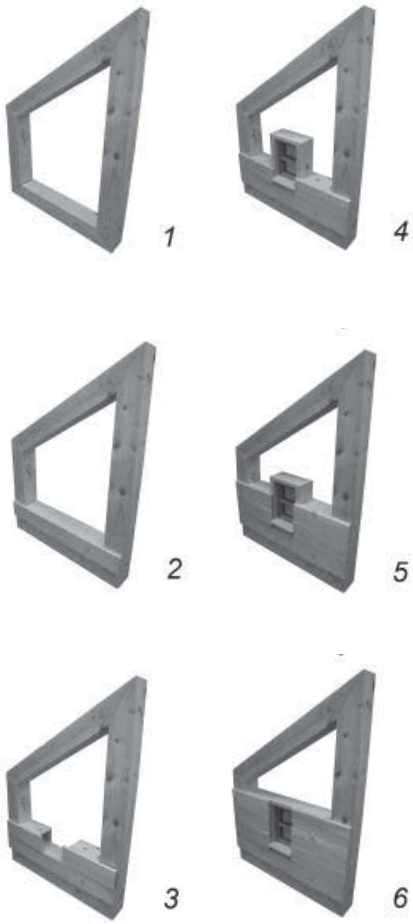
Tel: 02920875980 Web: www.dru-w.co.uk
Contact: Steve Coombs coombss@cardiff.ac.uk

Design Research Unit Wales (DRU-w), based in the Welsh School of Architecture, was set up in 2001 to concentrate on architectural, urban design and landscape projects from the position of research. The Unit undertakes projects, often in collaboration with other specialists, that provide the opportunity for the development of design studies based on research or as research in their own right. The work of the studio has recently been recognised nationally with DRU-w runners up to the **Young Architect of the Year Award** (YAYA) 2007; projects have been published in the Times, Building Design, the Architect's Journal, and featured on BBC's Culture Show.



Coed Cymru
The Old Sawmill, Tregynon, Newtown, Powys SY16 3PL
Tel: 01686 650 777
Contact: David Jenkins
Coed Cymru is an all Wales initiative to promote the management of broadleaf woodlands and the use of locally grown timber in Wales. Coed Cymru have a long and notable track record of innovation in wood products from building components and furniture and fittings through to certified building components. These are rooted in the real need to sensibly exploit homegrown products so that the benefits feed back to conserve, strengthen and conserve the indigenous forest.

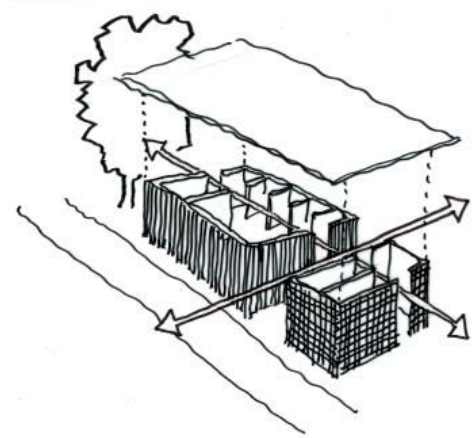
Environmental Resource Classroom, Ebbw Vale

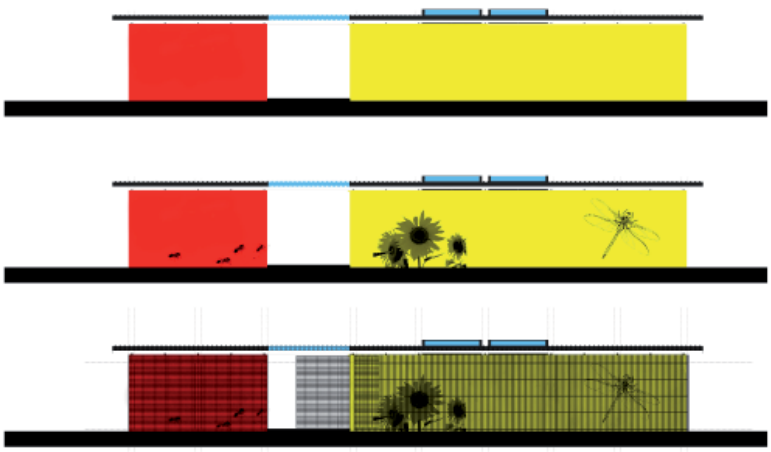
12.01.2009

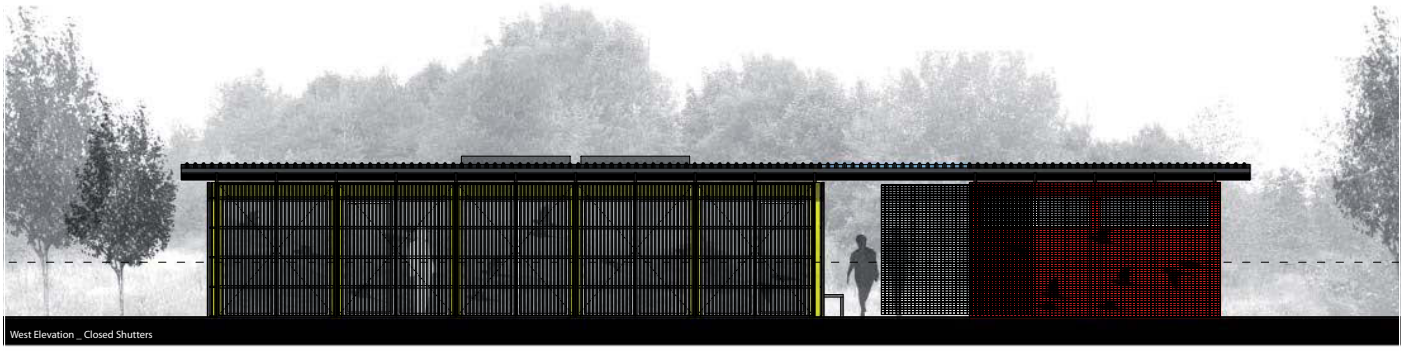
This 140sqm Environmental Resource Classroom (ERC) is the first building on The Works site in Ebbw Vale and first to use an innovative Welsh Sitka spruce construction system, called Ty Unnos - a house in a night. The ERC is located adjacent to the former pumphouse and filtration tanks, which have become a haven for wildlife since the closure of the steelworks. The classroom is located to respond to this geometry, creating a simple rectilinear form with two key axes: an oak access deck to exploratory boardwalks, separating the classroom and toilet zones; and separating a servant storage wall from the served classroom which opens out to views across the filtration tanks and valley beyond.

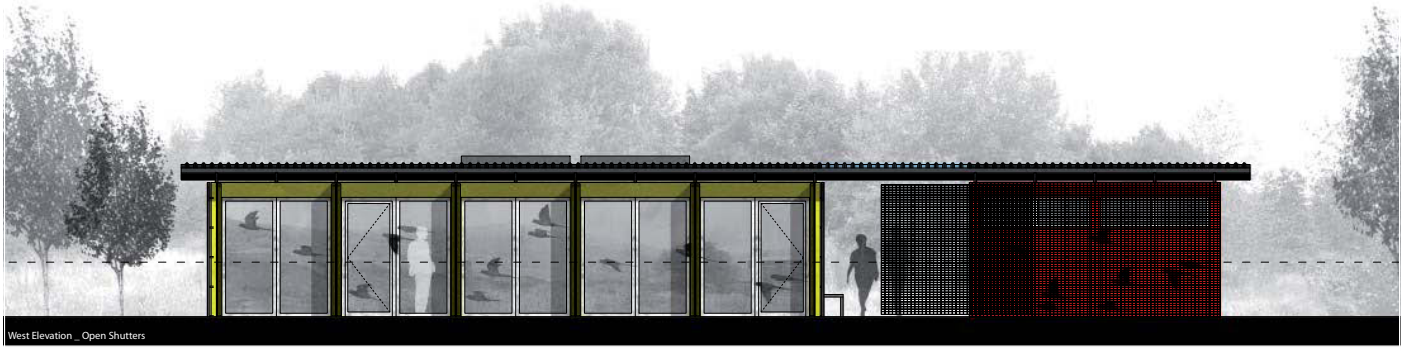
The brief required that the classroom used predominantly local materials and achieved a 60% reduction in energy use over Building Regulations. The response was a layered construction of timber frame, plywood SIPs, surface mounted services, EPDM rubber membrane, graphics panels, claddings and rainscreen roof that combine to create a didactic demonstration of sustainability through a heavily insulated fabric, passive ventilation, rainwater drainage channel and a high efficiency air to air heat pump, for additional heating and ventilation, supported by a solar hot water array.

The Sitka spruce construction system was developed as a collaborative research project between the design team of this classroom as a means to use a homegrown, sustainable, low-tech and low-value method of stabilising Welsh Spruce, which is abundant in Wales but unsuitable for structural use due to its tendency to twist when drying. 270x210mm box beams are fabricated from off-the-shelf and readily available sizes of spruce for use in portal frames. This first prototype comprises 9no. 7.2m portal frames at 2.4m centres with birch and spruce plywood Structurally Insulated panels (SIPs) between for floor, walls, doors and roof, giving a U-value of 0.15 W/m2K. These panels were coated with an intumescent fire retardant and kept exposed as the internal finish for walls and ceiling. Prefabricated off-site, the superstructure was assembled in 10 days with end grain






West Elevation _ Closed Shutters

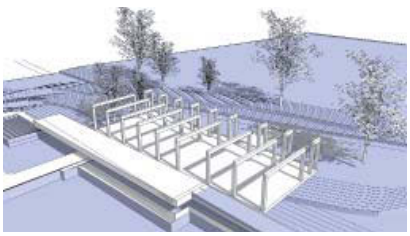
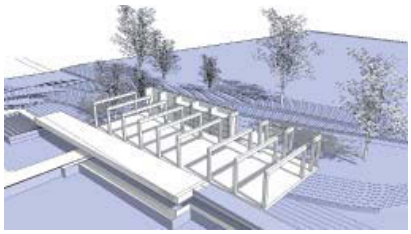
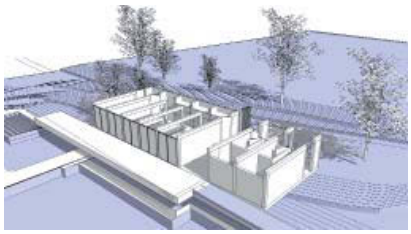

West Elevation _ Open Shutters

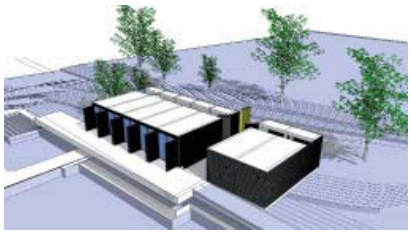
bolting at all joints between box section posts and beams.

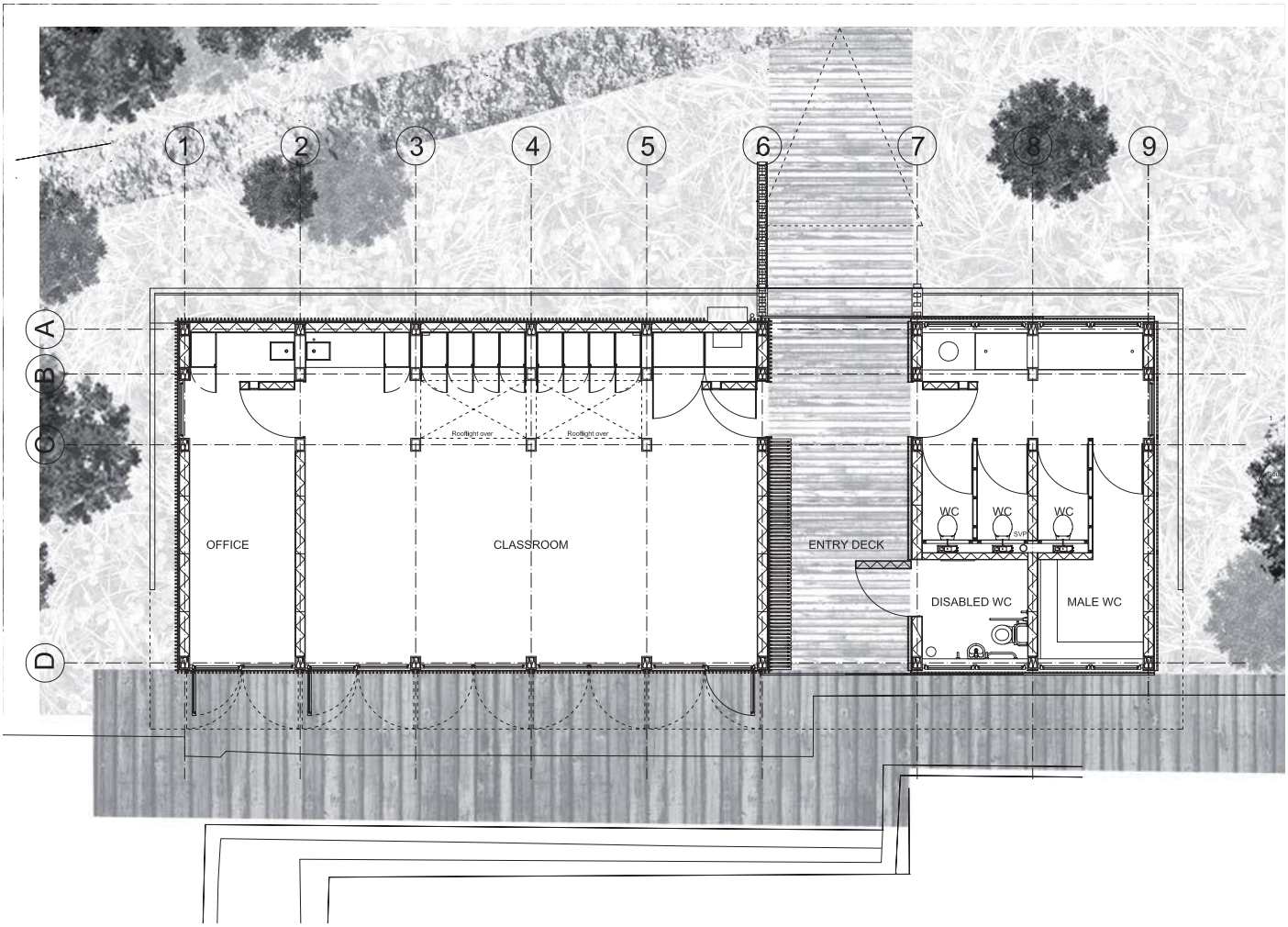
Internally, prefabricated birch plywood and recycled paper pin board units create a storage wall along the rear of the classroom, containing services, a range of modular storage, and wet spaces. To the front of the classroom Welsh laminated oak windows open up to the valley and reed beds with integrated vent panels for occupant comfort control.

Externally the building opens to its immediate industrial setting and wider landscaped context, through sliding and folding screens. The layered facade creates a play of colour and depth with red, yellow and black steel panels of wildlife supergraphics themed on four local habitats: woodland; industrial; wetland and grassland. These are concealed and revealed by vertical Welsh spruce cladding that has been charred to provide both water and fire resistance and blend with both the natural and industrial contexts. The service block is clad in a galvanised steel grating. An oversailing sinusoidal roof connects the two parts of the building and reinforces its horizontality, as well as providing solar shading to the glazed west elevation.

Credits:
Client: Blaenau Gwent County Borough Council
Architect: Design Research Unit Wales
Ty Unnos frame & engineering: Cowley Timberwork & Burroughs
M&E & foundation engineering: Halcrow Yolles
Planning consultants: Savills

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ENTRY DECK
WC
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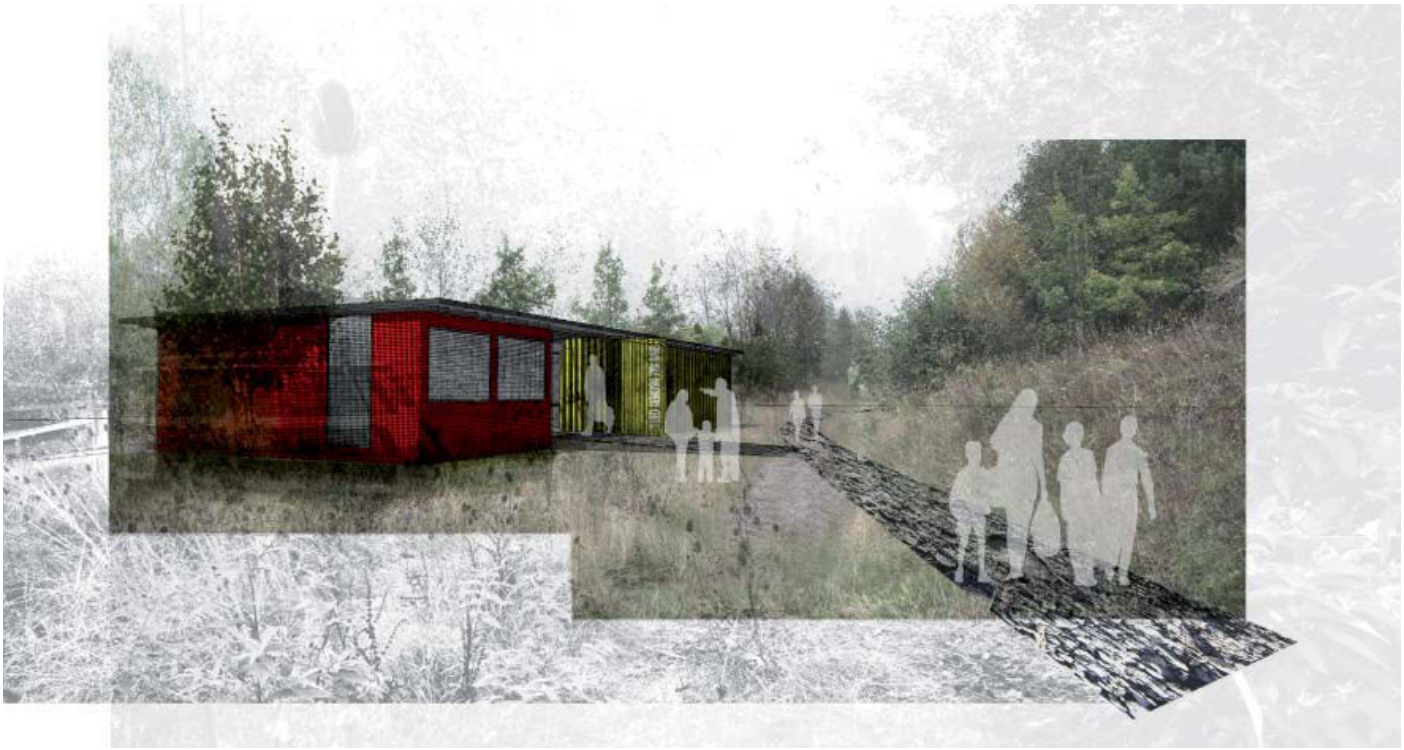
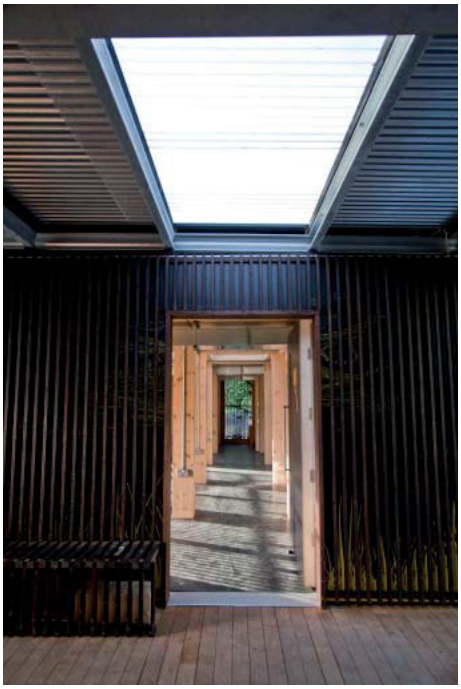
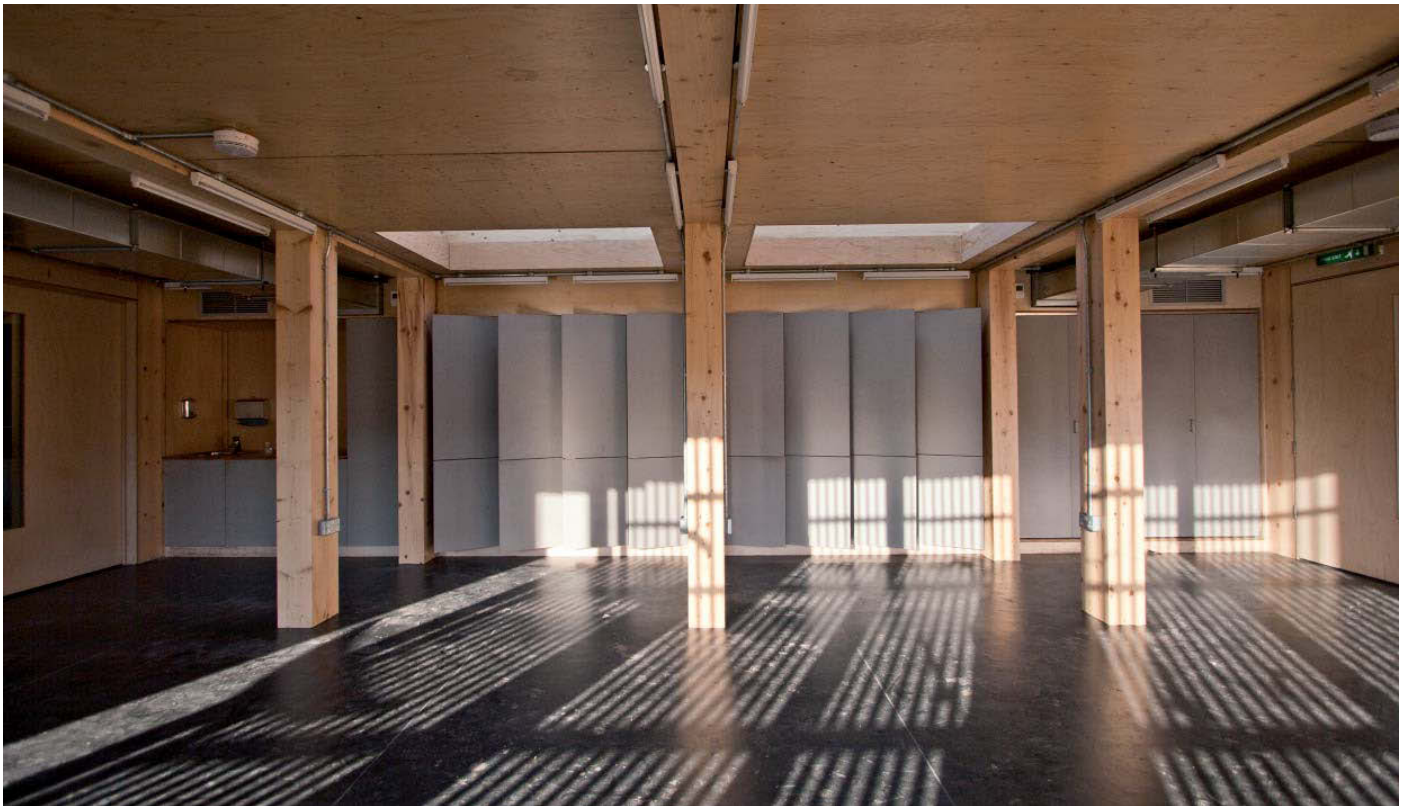
SVP
DISABLED WC
MALE WC



CONSTRUCTION SEQUENCE

1. Floor beams and Columns fixed to steelwork substructure and concrete strip foundations
2. Floor SIPS panels inserted and Wall SIPS panels dropped into location
3. Roof Beam installed to complete portal frame and Roof SIPS panels installed
4. Roof completed and Rooflight upstand installed
5. EPDM membrane applied and Roof substructure laid on Roof
6. Sinusoidal roof finish installed
7. Steel Cladding panels with applied coloured supergraphics
8. Charred timber rainscreen
9. Landscaped and finished building





Smithsonian Folklife Festival, Washington DC

07.2009

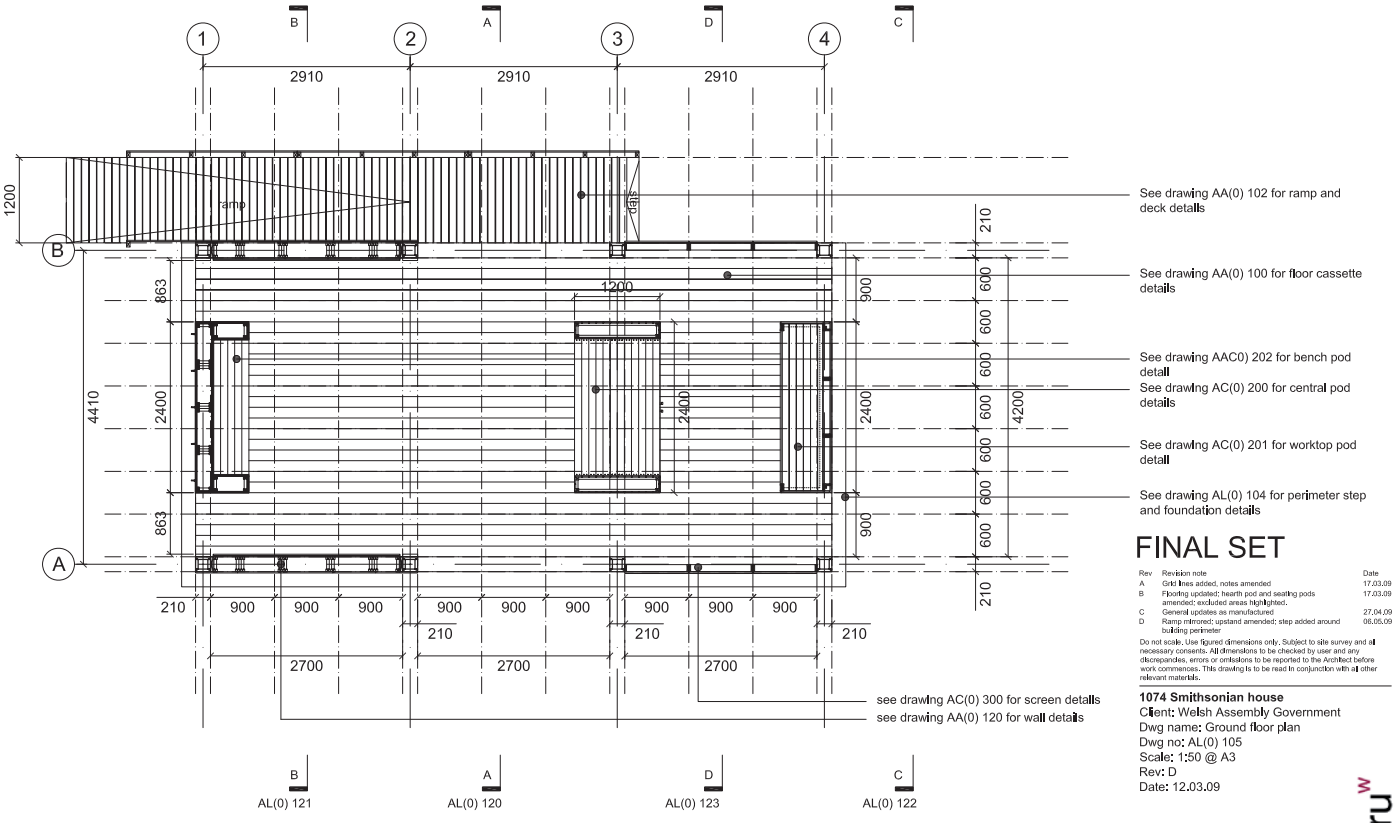
The pavilion was designed and built and erected in mid Wales, over 4 weeks, for the Welsh Assembly Government to send to the Smithsonian Folkilfe Festival in Washington DC in the summer 2009. The pavilion was to showcase Welsh forest from tradition to contemporary practice, and therefore in itself was an exhibit.

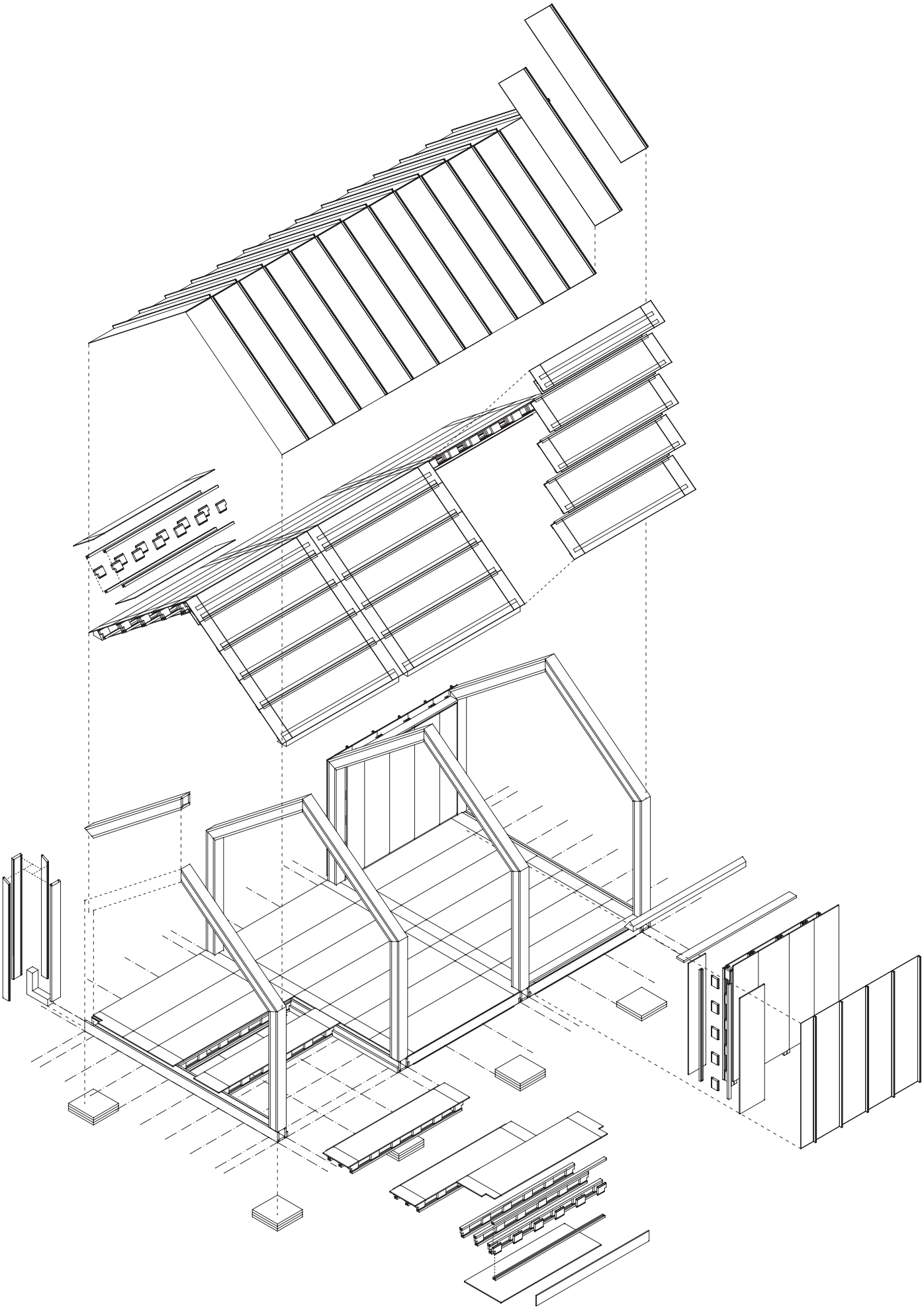
Aims and objectives

This project provided the opportunity to design and build a large scale prototype, of the first development within the Sitka spruce system, within the project team. It therefore enabled the detailing and physical construction of components to be tested for 'buildability' both off-site and on-site.

The following criteria were tested to coincide with the the deliverables and milestones of the first two quarters of the Technology Strategy Board project:

- Component tolerance;
- Component detailing;
- Component manufacture;
- Component assembly;
- Component engineering - structural performance;
- Appropriate specification of materials and sizes;
- Design performance within system parameters;





CONSTRUCTION SEQUENCE

1 - 4. Portal frames assembled on floor and lifted vertical at 2.7m centres concrete strip foundations

5-6. Floor infil panels of Spruce ladder beams with OSB internal and external finishes installed

7-8. Roof Infil panels installed and internal fit out commenced

9. Standing seam steel system applied to roof

10-11. External wall Infil panels installed and hit and miss shuttering applied to open pavilion

12. Finished pavilion


Tŷ Unnos,
Built by Coed Cymru

Plot 6, Ty Unnos Passivhaus, Future Homes, Ebbw Vale

07.2010

The house at Plot 6 of the Ebbw Vale Steelworks site will be the first house to be constructed using the Ty Unnos construction system when completed in July 2010. The house was first entered into the Future Works Housing- Welsh Passive House Design Competition 2009, as a three bedroom longhouse. Following the successful achievement of third place, the design team were invited to deliver the house as the entrance visitor centre to the Future Works Housing site, opening for the National Eisteddfod at Ebbw Vale in July 2010 before being converted into a home within the following 12 months.

The house establishes the complex brief of combining the German PassivHaus performance specification with a desire to locally source labour, and materials within Wales, in addition to meeting the Design Quality Requirements and Lifetime Homes. Working with local builder G Adams and the Building Research Establishment, local suppliers, and manufacturers have been integrated into the project and assistance given in the development of products that can meet the stringent criteria of PassivHaus. This includes the development of the first Welsh window to strive for PassivHaus certification.

The dwelling which forms part of the Future Homes showcase site, will be part of the first residential development to be delivered on The Works Masterplan area. It will have a significant impact in setting the standards for subsequent development phases and forming the character of the new neighbourhood. It will be the focus of local and national attention regarding its success in delivering the exemplar sustainable development objectives required by The Works Masterplan.

Reinterpreting a Welsh Vernacular

The design of the house draws its inspiration from the local context of Ebbw Vale and the wider context of Wales, making it an ideal model of economic, social and environmental sustainable housing for The Works site. The house design draws on several key ideas:

The Longhouse: The design of the house is a re-interpretation of the traditional Welsh longhouse vernacular for the 21st century. A linear access route runs along the southern edge of the site, giving access to the longhouse and garden.

The linear house looks south across its garden to the hills beyond, while the
first floor offers views up and down the valley to north and south.

Simple forms: Drawing on the simple forms of Welsh barns, longhouses and farm buildings, the house aims for a simplicity of planning, materials and detailing. A restrained but elegant palette of vertical timber cladding, white render and standing seam roof are used to develop a contemporary interpretation of traditional vernacular buildings.

Colour and composition: The addition of colour to a terraced house is a common way of personalising Welsh Valleys housing. The house will use colour to add personalisation, in this case coloured panels will be used on the elevations of the dwelling.

Environmental Principles

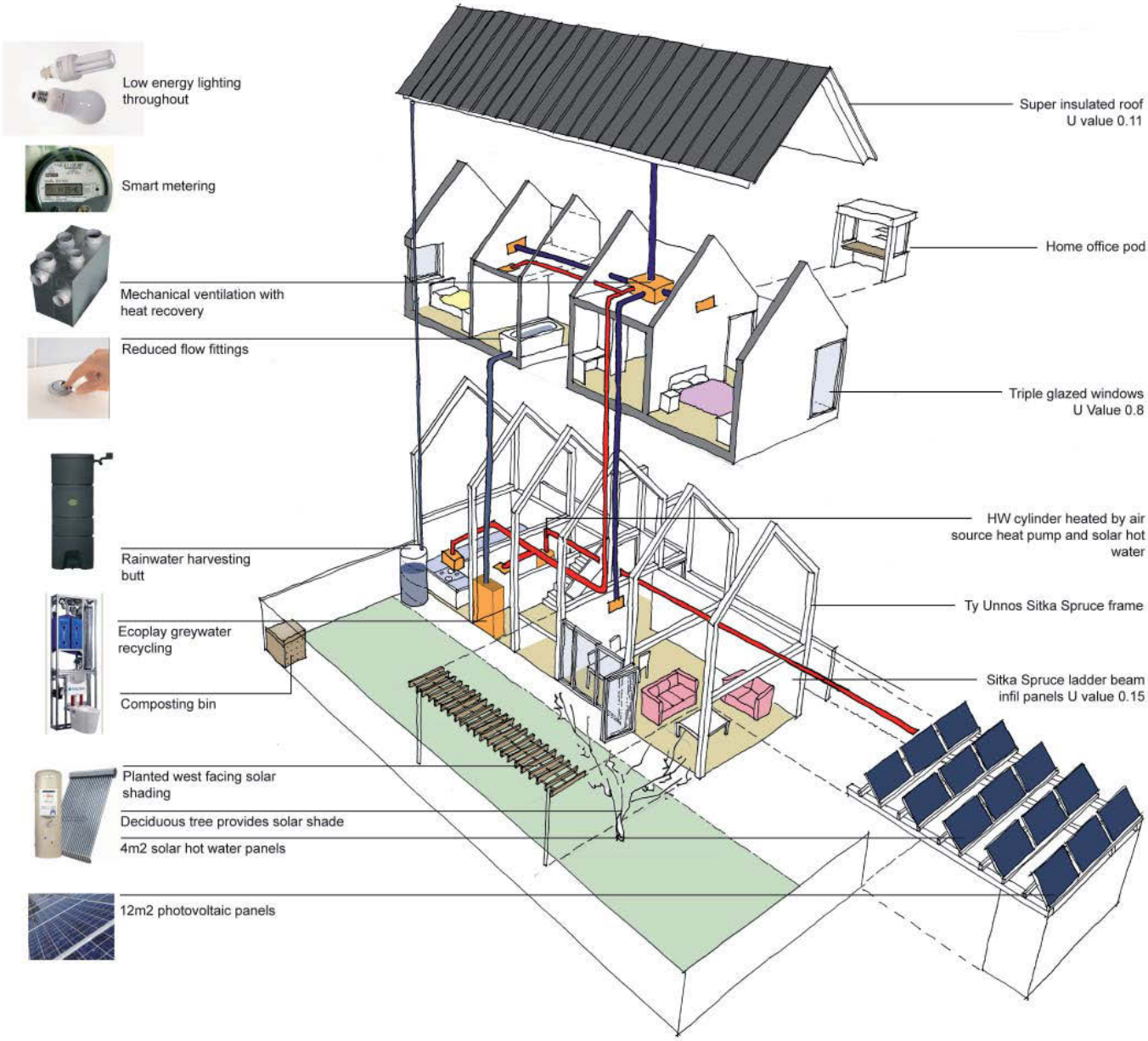
It is the aim of the Sitka Spruce Longhouse to reach Coade for Sustainable Homes Level 5 and be a Welsh Passive House using the following methods;

Energy Performance

- Walls and floor U values 0.12 W/m2K, roof U value 0.10 W/m2K;
- 0.8 W/m2K triple glazed composite windows;
- Total energy demand for space heating and cooling <21kWh/m2/yr;
- Mechanical ventilation with air source heat recovery; Air source heat pump with solar hot water for water heating demand;
- Ty Unnos system details are designed to achieve air permeability of 1m3/hr/m2 at 50 Pa as well as reducing thermal bridging;
- Lighting: 100% low energy fittings throughout;
- Airing cupboard with fittings;
- A++ labelled white goods;
- Cycle storage for 2 bikes; and
- Designated home office.

On site renewable energy

- 4m2 Solar hot water array



Coed Llandegla Forest Visitor Centre

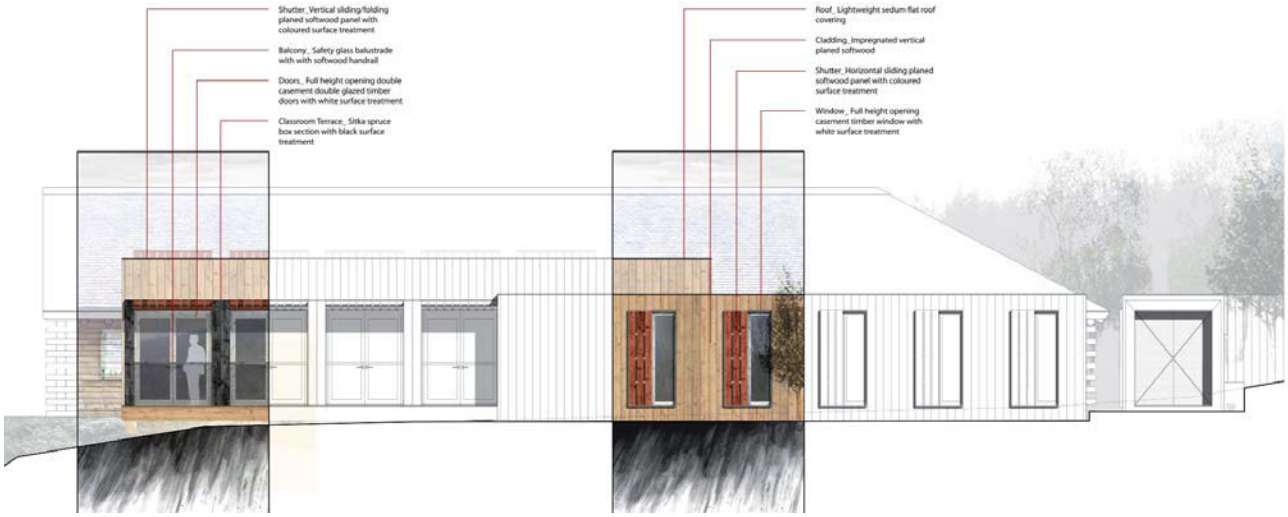
05.02.2009

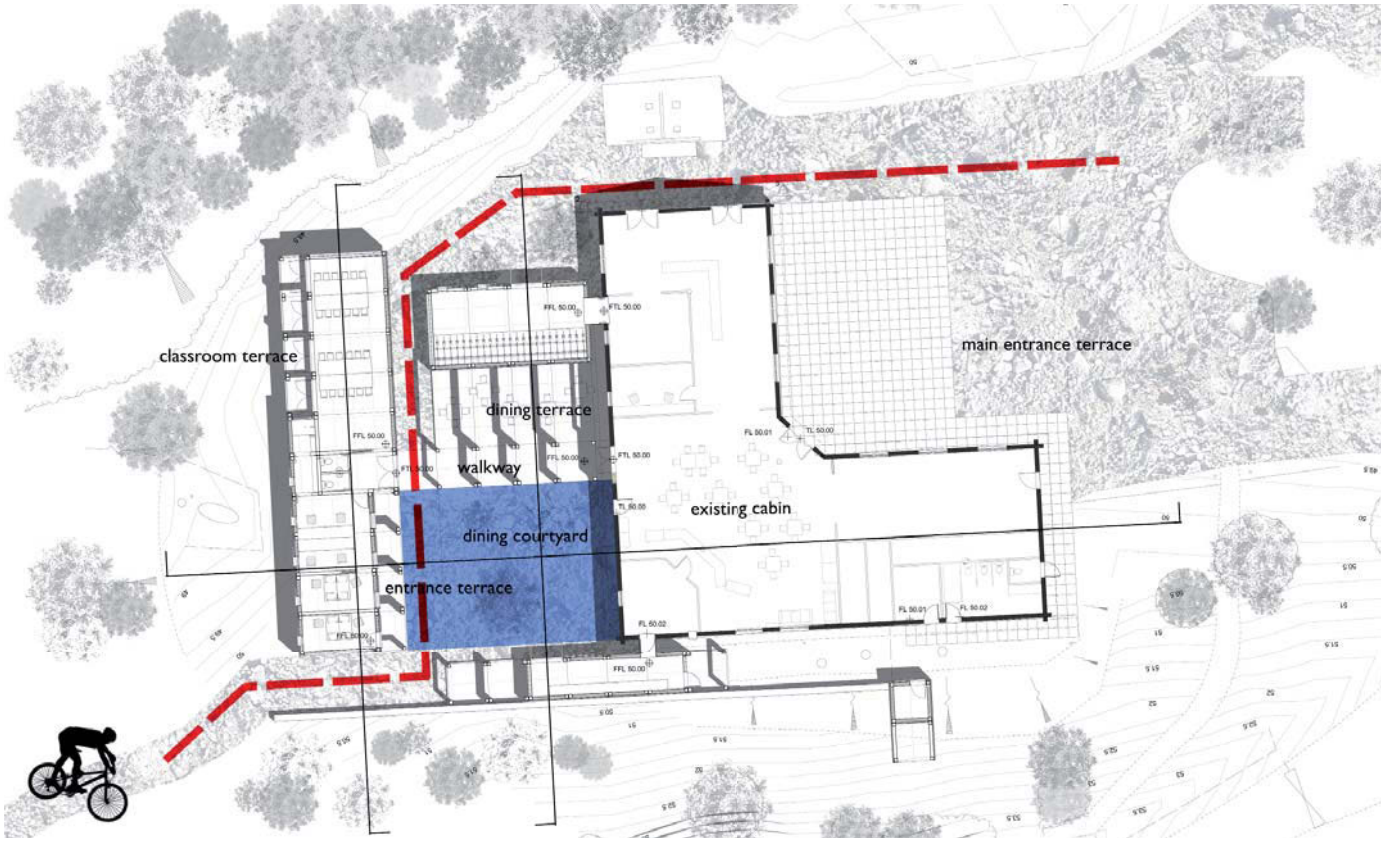
Coed Llandegla Visitor Centre owned by UPM Tilhill and operated by Oneplantadventure, has been granted planning to extend the leading privately owned forest visitor centre in Wales.

Coed Llandegla Forest covers 650 hectares and is one of the largest privately owned recreation facilities in North Wales. Llandegla was the first privately-owned forest in Wales to be recognised as a source of sustainable timber and to carry the Forest Stewardship Council logo. It grows at a rate that allows the harvesting of 7,000 cubic metres of timber per year.

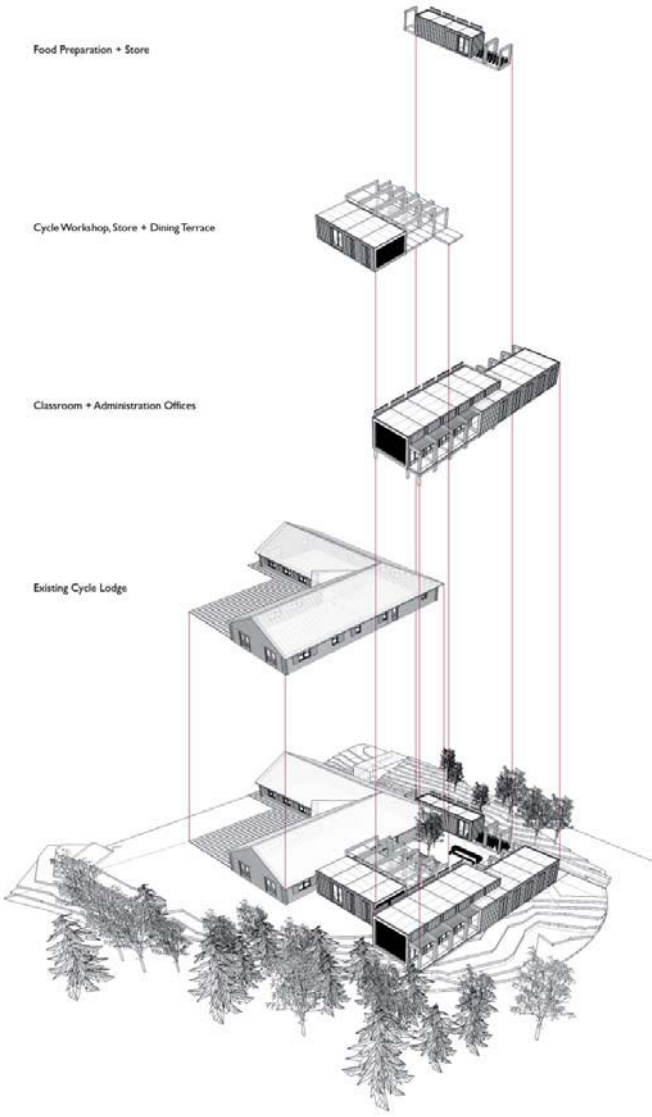
Llandegla Forest Visitor Centre was opened in 2005 as a centre for mountain biking and outdoor activities within the heavily sloping site of Coed Llandegla Forest. To the East of the proposal, sited on a man-made terrace, is the existing Log Cabin, which houses cafe facilities, a cycle shop and workshop, cycle hire shop, toilet facilities and a classroom. Since its construction in 2004, the Centre's reputation has rapidly grown and established itself as one of the leading biking centres in Wales. This reputation now draws upwards of 600 cyclists a day at peak periods.

The Centre has recognised that it's current accommodation is inadequate to meet the demanding requirements of such a rapidly growing community of cyclists and walkers. Of particular concern is lack of sufficient storage space, and public showering facilities. UPM Tilhill therefore intend to make a number of sensitive additions to the existing accommodation to ensure that the centre can continue to offer safe and enjoyable recreational facilities. This will be partnered with a series of amendments to the existing mechanical and electrical systems, including the addition of a wood pellet boiler, and a reed bed system.

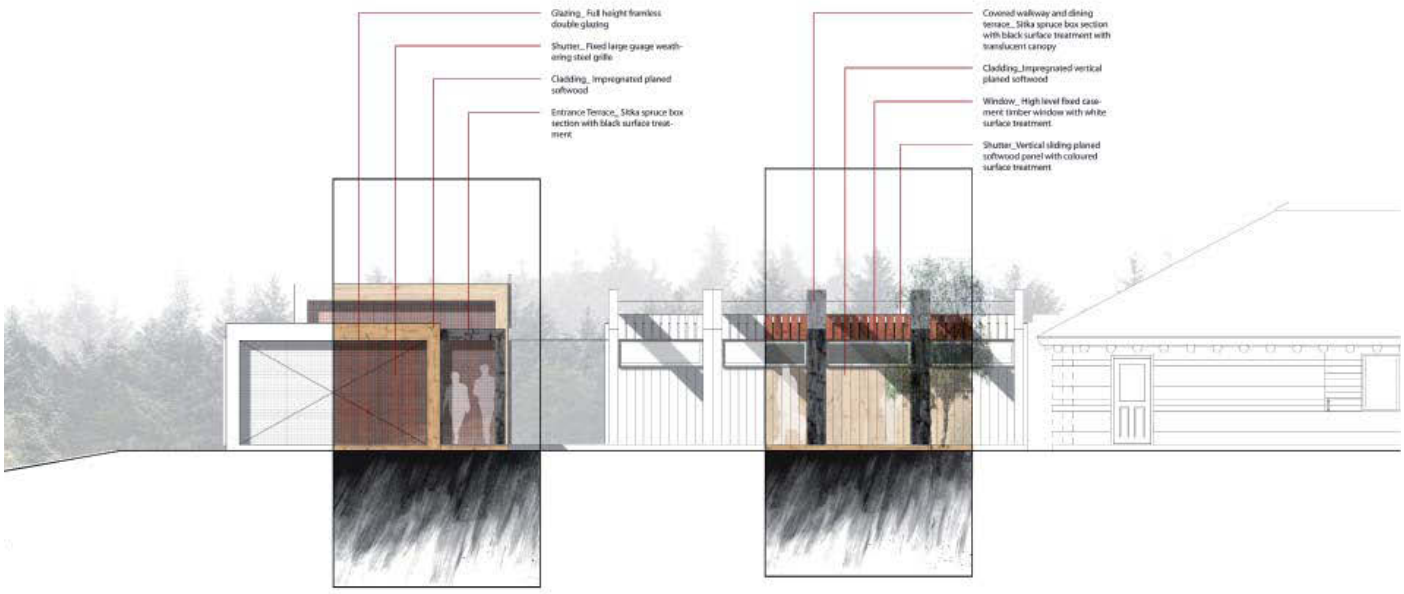




The proposal is designed to form a gateway welcoming the returning cyclist back to the Visitor Centre. The proposal is broken into 3 elements defined by function. The elemental plan and single storey massing reduces the visual impact of the building on its site, sitting sensitively against the low massing of the log cabin. Changes in the roof line identify functional changes and external terraces draw connections between the separate elements. The role of external spaces are a critical element of the design proposal. The arrangement of elements form a protected courtyard which captures the maximum sunlight and offers sanctuary from the extremes of weather, received by the North facing sloping site. Sheltered terraces offer protected dining spaces for use in all weather and a large landscaped courtyard allows for less formal use. A cantilevered classroom terrace with opening fenestration provides additional intimate workspaces for the classroom in summer, whilst offering uniterrupted views across the surrounding landscape.



The appropriateness of the system to its site is the primary concern of the client UPM Tilhill, as the Research project's primary aim is to give added value to locally-grown softwoods, the very material that defines the site. The centre is the one of a series of projects to use the Ty Unnos construction system, developed by DRU-w and Coed Cymru and fabricated by Cowley Timberwork. 270x210mm box beams have been developed as a low-tech method of stabilising Welsh Spruce, which is unsuitable for structural use in its common form. These are combined to create portal frames in different modular sizes. Frames are infilled with spruce faced plywood SIPS panels for floor, roof and walls, giving a U value of 0.15. The spruce face plywood, a UPM Tilhill produce, of the SIPS is revealed as the interior finish to all wall and ceiling surfaces, and combined with hardwearing materials to floors and internal finishes. Internal non-structural walls are articulated in bold primary colours and provide integrated storage units.

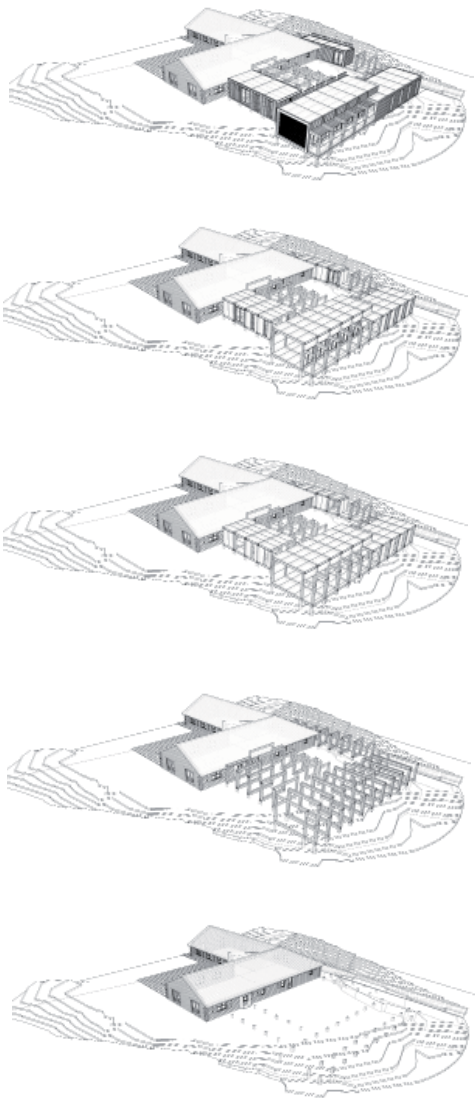


Externally the construction draws on its context, using locally sourced vertical softwood cladding. This lightweight vertical weather boarding is in direct contrast to the structural log on log construction of the existing centre. A key element of the design brief was the integration of security shuttering due to the exposed nature of the site. Sliding shutters are therefore integral to the elevational composition, and are aticulated, in conjunction with windows and terracing, through the use of colour.

The centre aims to achieve a reduction in energy use over Building Regulation standards of 60%. This will be achieved through a heavily insulated fabric achieving a U Value of 0.15 for walls, roof and floor, and passive ventilation. This is supported by an M&E scheme which includes a solar hot water array for water heating, supported by wood pellet fuel boiler which provides underfloor heating and additional hot water capacity, and a reed bed filtration system.

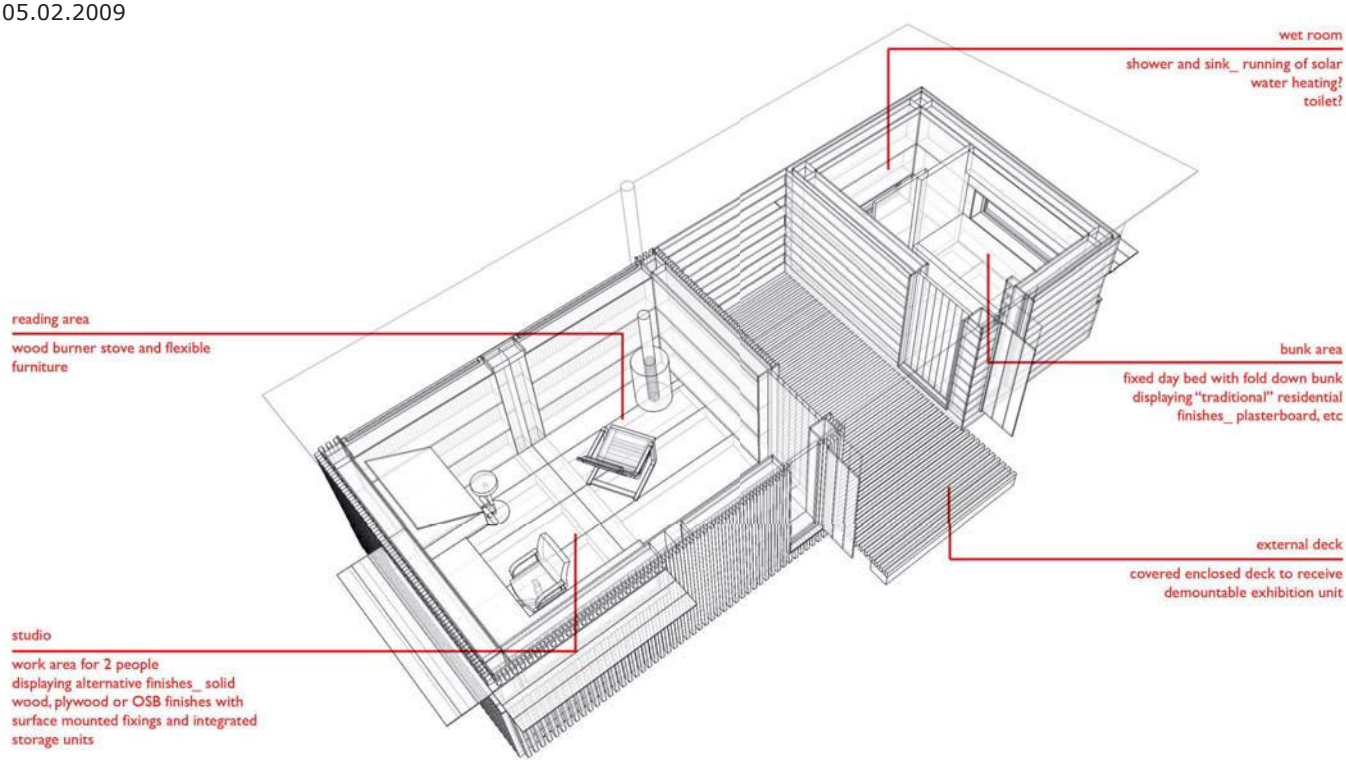
The scheme is currently awaiting further fund raising, following completion of planning requirements and development of construction drawings for tender.

Credits:
Client: UPM Tilhill
Architect: Design Research Unit Wales
Ty Unnos frame & engineering: Cowley Timberwork & Burroughs



Rural Studio, Tregynon

05.02.2009



Situated on the grounds of the Coed Cymru head office at the Old Sawmill, Tregynon, a small unit will offer a satellite workspace for Design Research Unit Wales and provide Coed Cymru with a demountable exhibition unit. The unit, funded by the Countryside Council of Wales, will primarily act as a prototype unit to allow the hands-on development of construction methods and detailing.

The unit will combine the sitka spruce portal frame system with a spruce based infil panel and ladder beam, providing a test bed for the development and testing of the system addressing thermal performance, air tightness, construction detailing, and ease of manufacturing within a low technology manufacturing context.

The building will act as a showcase for Welsh timber projects developed by Coed Cymru and their project partners, therefore elements such as windows, cladding, and flooring finishes will be developed and integrated into the system. It will also provide a pilot study for an investigation into the 'whole' welsh building, integrating the development and testing of dimensionally coordinated modular furniture.

Credits:
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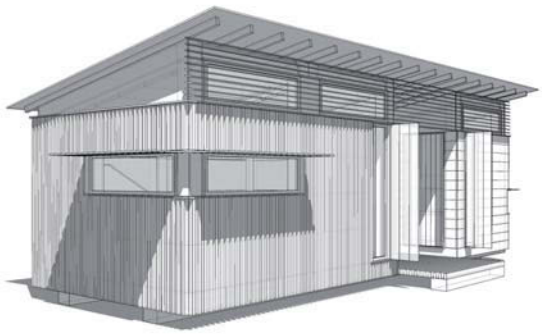
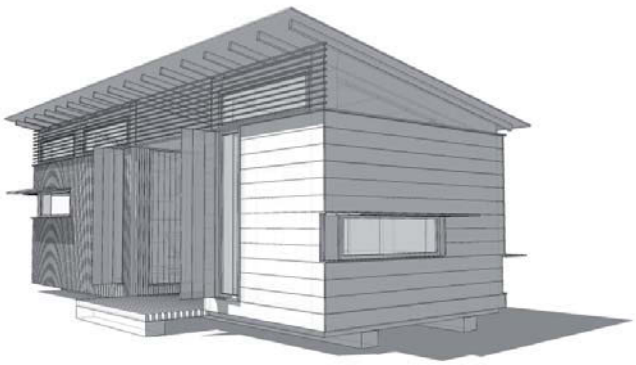
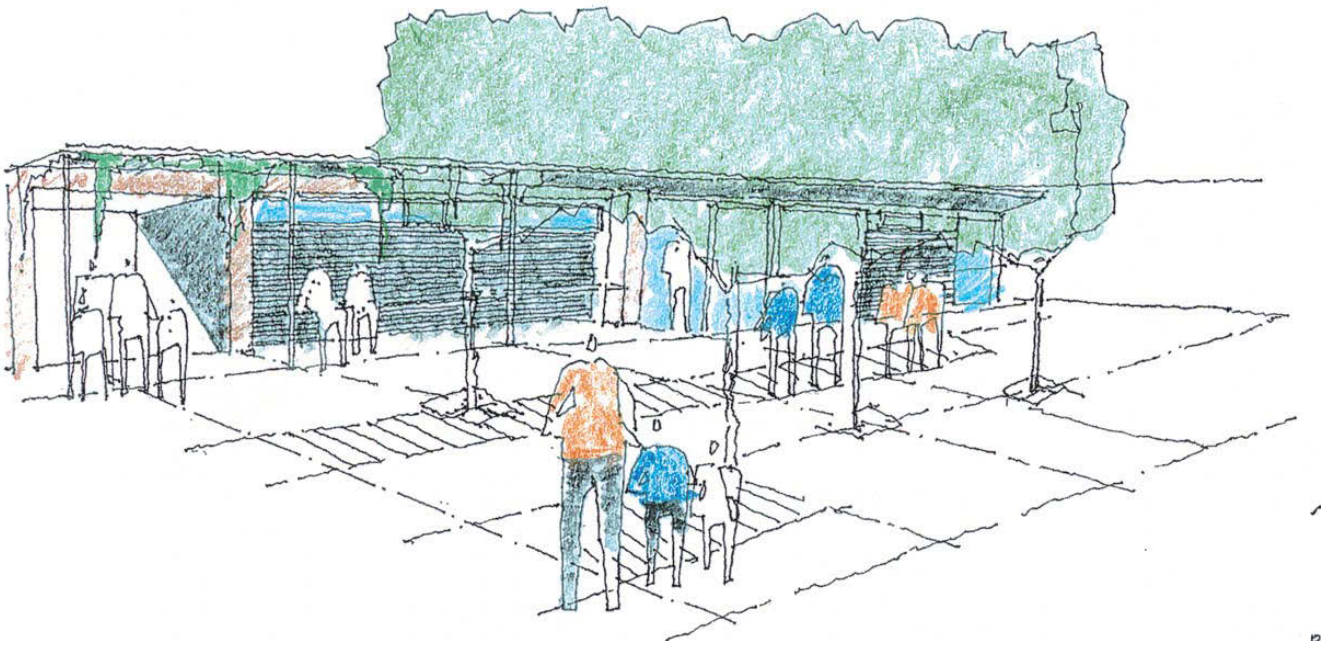





The Old
Sawmill
Car Park
Studio
FB
161.5m
The Old

Carew Castle Visitor Centre

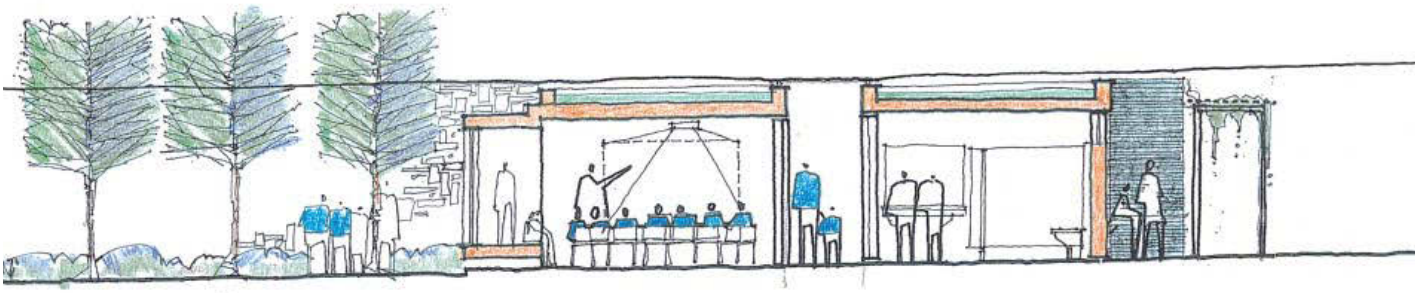
23.12. 2007

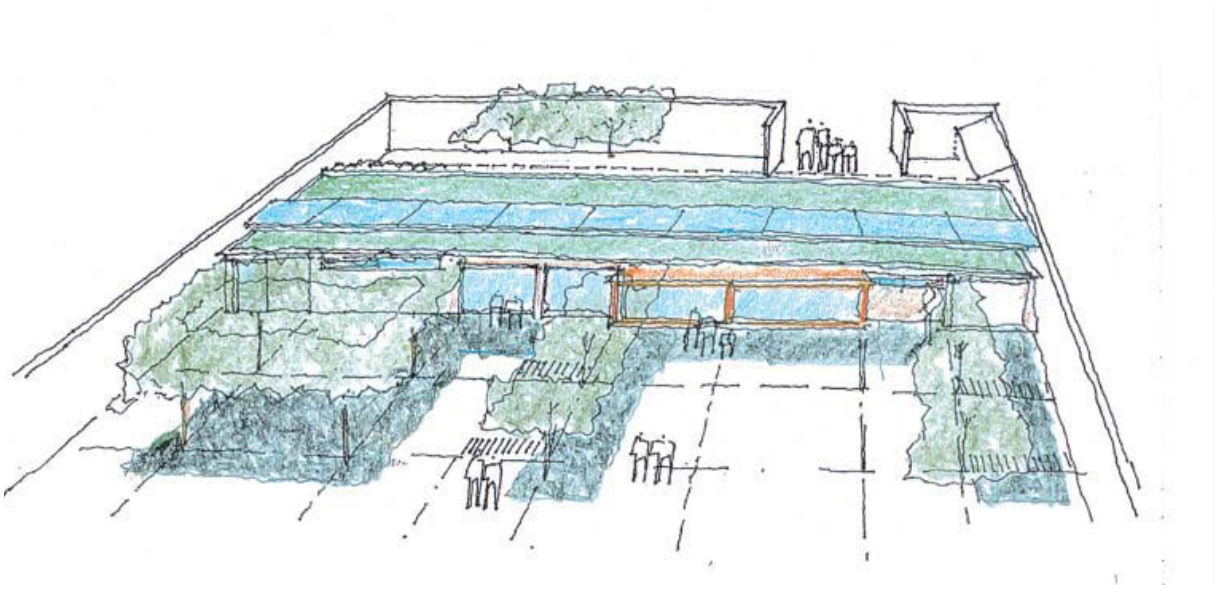


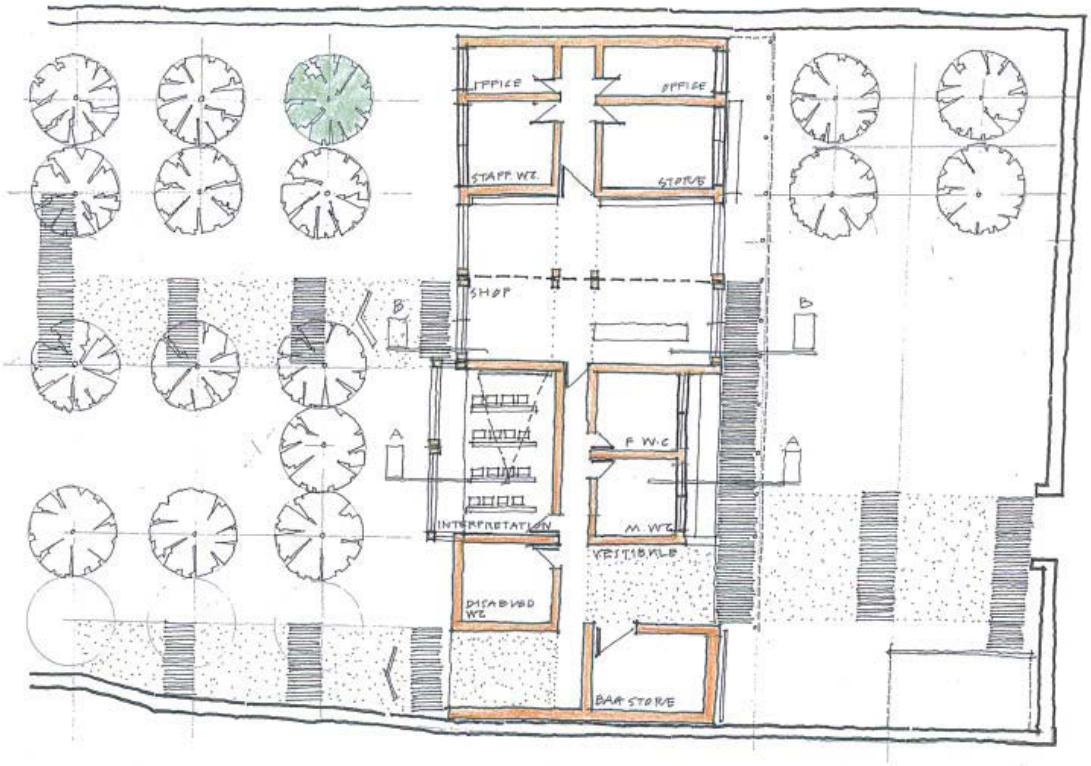
This scheme for Carew Castle Visitor Centre is located in the walled garden close to the entrance to the castle. The brief is for a visitor and interpretation facility, including offices, shop, interpretation classroom and facilities for visiting schools. The building is seen as a integrated into the formal landscape of the garden, with greened edges, a green roof and a landscape strategy that ties into the geometry of the wall and the traditions of the walled garden. The building aims to nestle into the walled garden; its roofline is kept below the surrounding wall, making the building visible only from the castle walls.

The Ty Unnos construction system is used throughout the building. The building is two modules in width with a glass roofed circulation zone linking the two. Modules are either enclosed using SIPS panels and finished in horizontal timber cladding to create offices, toilets and stores, or left open to create flexible and open spaces for interpretation and reception areas, which are glazed. Two entrances separate school parties from general public, linked by the glazed central link.

The elevations are animated by a pergola along the entrance facade which is greened to provide solar shade. To the castle side, pop out bay windows in bold colours give the elevations depth. A considered landscape, access and paving strategy embeds the building into its site and links the building to its context.






OFFICE
OFFICE
STAFF WC.
STORES
SHOP
B
B
A
A
F W.C
INTERPRETATION
M. WC
VESTIBULE
DISABLED WC
BAR STORE