



YSGOL

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in collaboration with:



2 introduction

'The low carbon option is the only viable future to pursue. An innovative system which offers a practical solution to this challenge as well as offering jobs and training in the provision of affordable homes is not only promising, but the development of the Ty Unnos system, using a readily available resource from home grown Welsh timber, may be one of the big opportunities of our times.'

Climate change, fuel poverty, homelessness and unemployment require swift responses to ensure environmental and community resilience. Ty Unnos, now an award-winning system, has been attracting increasing interest because it is able to add value to the timber supply chain, offer job and training opportunities for the timber and construction industries in rural areas and provide energy-efficient, affordable homes using a renewable resource from Wales.

After years in development, I believe Ty Unnos now deserves wider attention to increase both the affordability and range of the product and to demonstrate an exciting response from rural Wales to the key challenge of our times.'

Jane Davidson

Former Assembly Member minister for the Environment, Sustainability and Housing

Director, INSPIRE (Institute for Sustainable Practice, Innovation and Resource Effectiveness),
University of Wales, Trinity Saint David

For the Supply Chain Efficiencies Scheme.

Building on the award winning Ty Unnos research and development project, YSGOL is one of a new range of products offering a full turn key architecturally designed construction solution combining homegrown Welsh timber with natural and recycled building products. Designed to surpass local building regulations, the innovative prefabricated construction system offers a flat pack whole building system suitable for permanent applications or as a solution to temporary building demands without any compromise in quality or performance.

Since its inception in 2007, the Ty Unnos research and development project has designed, tested and developed a range of innovative homegrown timber construction components, designed specifically to enable the greater use of technically poor, low value homegrown timber resources in the construction industry. Through a rigorous process of prototype studies, formal testing and certification, including application in a number of award winning buildings, the project has resulted in a market ready range of engineered homegrown timber construction components.

The next iteration in this project, offers an innovative, sustainable and low cost whole building construction system appropriate for a wide range of applications. YSGOL applies a kit of standardised construction components to provide an alternative construction solution for education demands. Flexible and interchangeable large span components are combined in a wide range of iterations to provide permanent quality classrooms, multi use spaces, offices and specialist education accommodation. YSGOL offers an alternative and innovative construction solution for both short and long term accommodation demands. Grown, manufactured and constructed in Wales.

The YSGOL concept is offered as a complete solution for the education establishment, providing a fast, environmentally friendly and efficient building solution, making sustainable use of a naturally occurring Welsh asset.

3 the story so far...

Originating in 2007 as a Research and Development project, Welsh woodland management charity Coed Cymru, in partnership with the Welsh School of Architecture, University of Wales Bangor and leading timber specialists, set out with the ambition to meet a number of acute local and national needs;

- to address the critical shortage of affordable housing in rural Wales and,
- to exploit a technically poor low value local resource for application as a complete sustainable and low impact building system.

The project was given the title Tŷ Unnos, “a house in one night”, after the Welsh tradition, dated to the 17th Century, when it was believed by some, that a person may build a home on common land and claim the land as freehold, if the house is complete, with smoke in the chimney, by the time the sun rises.

Wales has over 150 thousand hectares of coniferous plantations which produce approximately 1 million tonnes of softwood in the round per annum. Over 70% of this production is Sitka Spruce. In its native range of North America, Sitka spruce grows slowly to a great age. British spruce however grows much faster producing timber of lower density with heavier branching and larger knots. It is processed for a number of markets including fencing, wood fuel, chipboard and pallets, but the most important commodity produced is carcassing timber which is machine graded to C16, the lowest strength class in general use.

Homegrown Sitka Spruce is seldom used in modern timber frame construction, with manufacturers typically utilising imported softwoods because of the greater stability and superior strength of slow grown softwood from cooler and drier climates.

Taking this local and low cost resource as a basis, the Tŷ Unnos project team have tested, developed and refined a system of engineered homegrown timber components using low intensity manufacturing techniques and readily available homegrown timber products.

In 2014, Mann Williams Engineers and Davies Sutton Architects combined to extend the application and adaptability of Ty Unnos construction components across alternative sectors, and YSGOL is a product of this collaboration.



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4 innovative timber components...

A feasibility study, commissioned in 2006, considered the possibility of building homes using homegrown Sitka Spruce. The simple substitution of home grown spruce for imported material in existing timber based systems was not deemed possible due to the greater stability and strength of slower grown imported softwoods. In particular, its tendency to twist during drying discouraged manufacturers from using homegrown supplies in any great quantity. The Tŷ Unnos partnership therefore proposed a radical departure from current practice in the form of a whole house construction system of engineered home grown timber components.

The Tŷ Unnos system combines readily available standard sections of home grown Sitka spruce with simple manufacturing techniques, available from the existing timber and pallette manufacturing industries, to deliver a range of engineered timber components. At its core are two simply assembled engineered timber components; a hollow box section beam and a small section timber based infill panel. When combined with frame connectors, 'breathable' sheathing boards, and natural and recycled insulation products, the engineered components form an innovative prefabricated whole building construction system capable of surpassing current national Building Regulations and reaching the higher levels of the Code for Sustainable Homes or BREEAM, using a fabric first approach.

YSGOL is the first in a range of new products to employ the system components. A range of standard design models are available using standardised and interchangeable high performance components, combined with prefabricated windows, doors and internal and external finishes- all sourced locally within Wales. Transported as a flat pack kit of parts, the system is appropriate for even the most constrained or rural site, with limited demand for heavy lifting equipment.

Developed and tested through the construction of a number of award winning buildings, the system offers a highly efficient prefabricated Modern Method of Construction which can significantly reduce impact on site and build programme.

Presented as a permanent quality construction system, the intrinsic flexibility and demountability of the construction components makes YSGOL a highly appropriate solution to temporary building needs. Primary structure and thermal infill can be constructed and de-constructed in days, with prefabricated internal and external finishes completing a greatly reduced construction programme over traditional construction methods. Flexible and adjustable, the system enables the opportunity for the building to be altered, extended, reduced, or moved multiple times through its useful life as demands change.

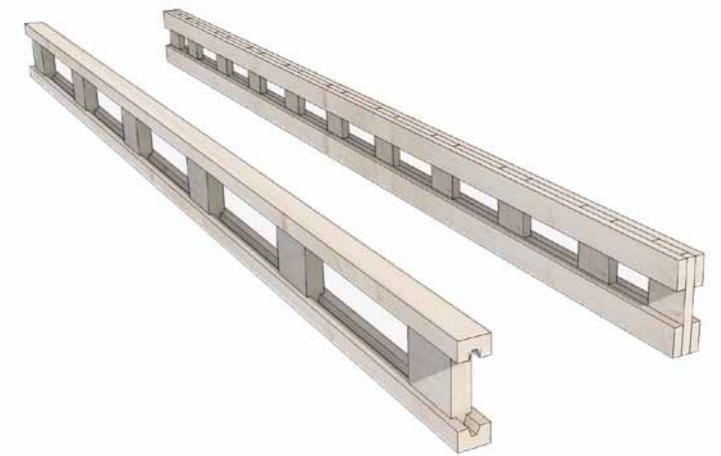
PRIMARY STRUCTURE Sitka Spruce Hollow Box Section

Up to 16m Span
Infilled with recycled newspaper insulation



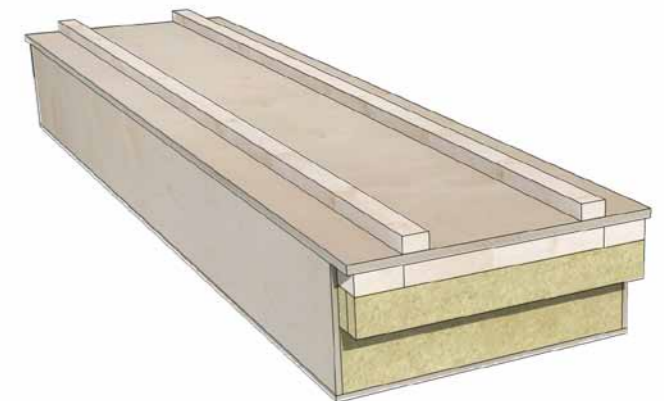
SECONDARY STRUCTURE Sitka Spruce Ladder Beam and Stud

Up to 3m Span
Reduced thermal bridging.
Adaptable to accommodate variable specifications of thermal performance.



THERMAL ENVELOPE Dimensionally Coordinated Infill Panel System

Up to 3.6m Span
Fully prefabricated in factory conditions
Infilled with recycled, natural and waste product based insulations,
Coordinated and interchangeable for walls, floor and roof,
Designed to be lifted and assembled by hand.

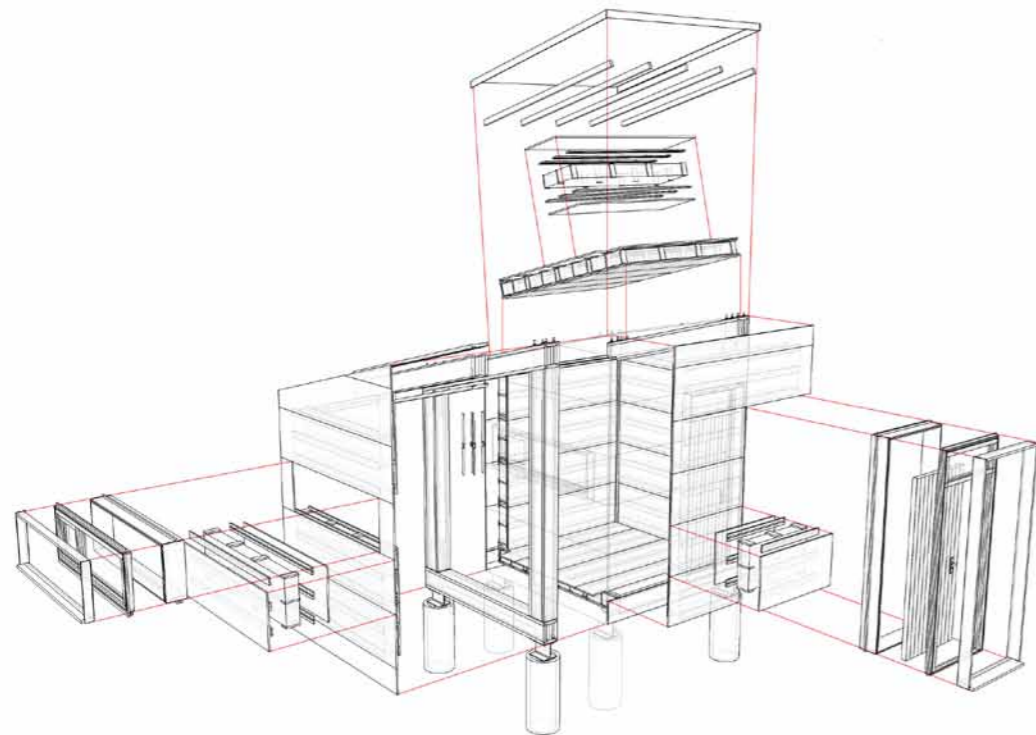


5 flexible and adaptable...

Based on these core ingredients, the system provides an innovative offsite construction solution for a wide range of alternative building types.

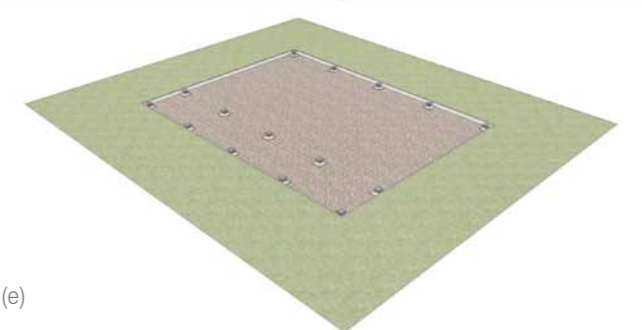
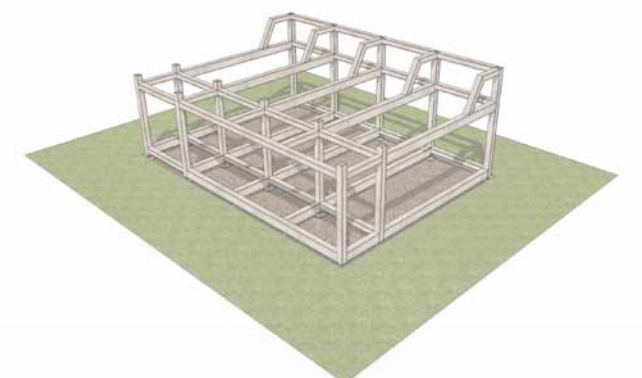
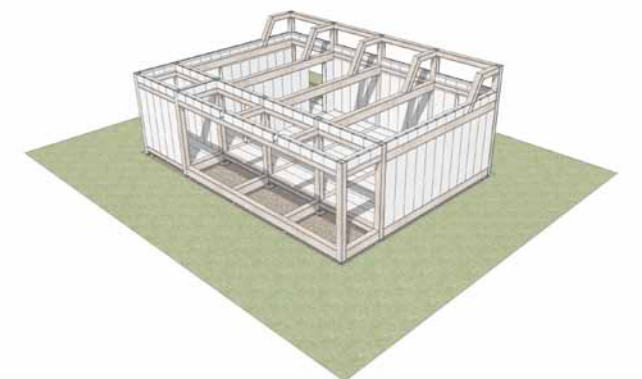
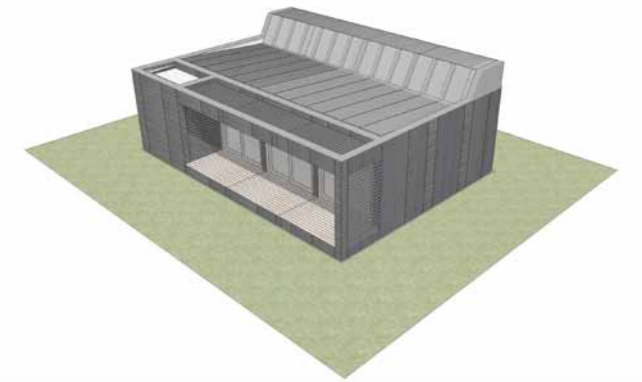
It is developed specifically to respond to the increasing trend for buildings to become obsolete before the end of their designed life. There is a well established market for short-life buildings however the existing market tends to offer fully finished volumetric solutions with limited flexibility and adaptability to meet changing demands.

The system offers an alternative to both 'temporary life' and permanent building requirements. Standardised prefabricated components, from foundations to thermal envelop to internal finishes, are designed for deconstruction, enabling an additive or adaptable architecture. This flexible building shell can be adapted to changing demands for space, whether it be at the scale of internal non-load bearing walls, or as modules added, or removed, or even perhaps as whole buildings, relocated across sites.



09 Assembly of the panel system including dimensionally coordinated windows and doors

- e) Apply lightweight prefabricated internal finishes and claddings to complete construction.
- d) Install insulated closed roof panels and prefabricated homegrown window, door and rooflight cassettes.
- c) Install a suspended timber floor and internal and external walls of standardised and interchangeable insulated closed infill panels.
- b) Assemble a post and beam frame of homegrown Sitka spruce insulated hollow box sections.
- a) Prepare piled or temporary precast foundations at primary frame nodes

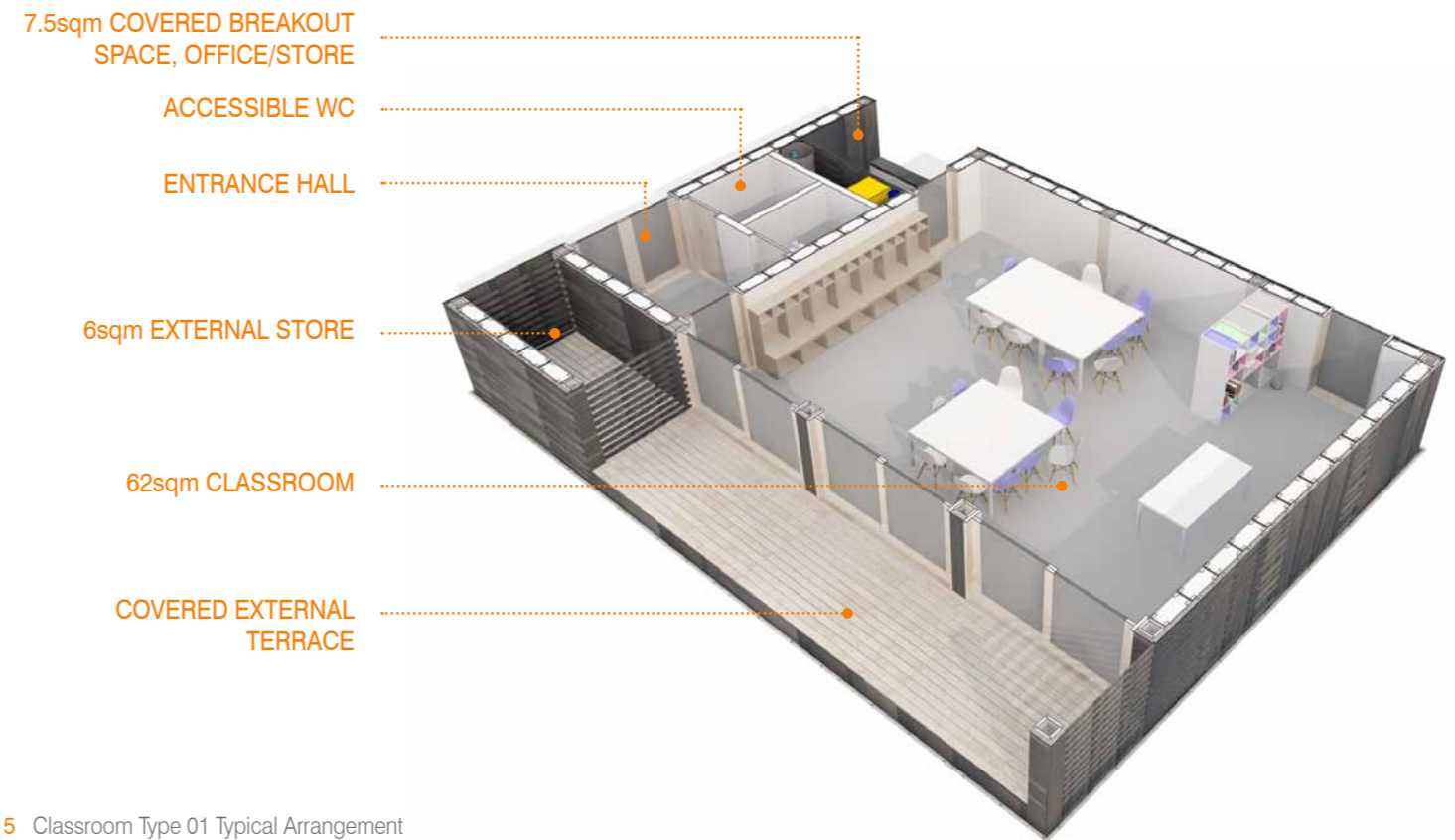


10 - 14 Assembling classroom Type 01 from foundation (a) to finished building (e)

6 classroom type 01

The range of standardised education buildings provided by YSGOL maximise design, construction and cost efficiencies. The first of these - Type 01 - is a stand-alone single classroom module of 90sqm gross internal area with external balcony and store. The single storey flat roofed building has a 62sqm classroom with 7.2m clear span, entrance hall, accessible unisex toilet and ambulant disabled WC cubicle. A 7.5sqm breakout space provides either covered external play area, office space or open plan work area to suit teaching requirements.

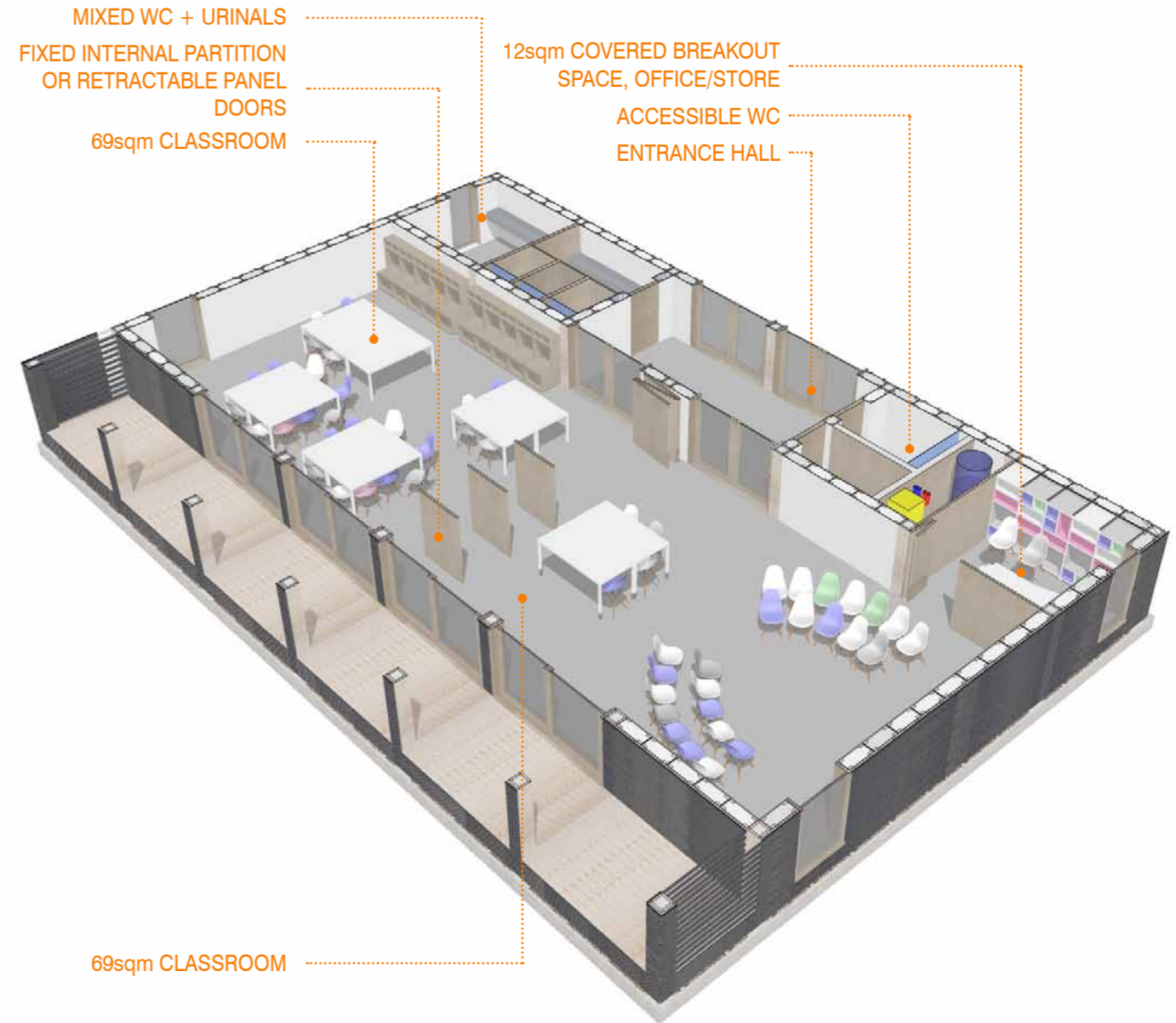
With the provision of optional mechanical and electrical systems including greywater store, photovoltaics and solar panels there is the potential to achieve an off-grid building solution, for both temporary and permanent applications. The example module combines prefabricated panels of treated homegrown timber cladding, metal sheet roofing, integral painted plywood internal linings, surface mounted services and homegrown timber windows and doors to provide a robust and high quality demountable and flexible building.



6 classroom type 02

YSGOL Type 02 provides a flexible, multi-use education space, considered primarily as a pair of classroom spaces, each suitable for a 30 - person class. A temporary or removable acoustically separating partition offers potential for an open plan space of 18 metres by 7.2 metres, suitable for sports, performance and group work. The single storey building has two 69 sqm classrooms with 7.2m clear span, entrance hall, accessible unisex toilet, mixed unisex toilets and urinals. A 12sqm breakout space provides either covered external play area, office space or open plan work area to suit teaching requirements.

With the provision of optional mechanical and electrical systems including greywater store, photovoltaics and solar panels there is the potential to achieve an off-grid building solution, for both temporary and permanent applications. The example module combines prefabricated panels of treated homegrown timber cladding, metal sheet roofing, integral painted plywood internal linings, surface mounted services and homegrown timber windows and doors to provide a robust and high quality demountable and flexible building.



17 Classroom Type 02 Typical Arrangement



18 A selection of recently completed classroom and public buildings

7 exceeding performance standards...

The proposal combines an ambition to fulfil the Passivhaus design methodology and attain the higher reaches of the Code for Sustainable Homes and BREAM as appropriate, with the progressive challenge of achieving these standards whilst employing natural, sustainable local resources, products, skills and industries.

In its basic specification the building comfortably surpasses current building regulations with the capacity to specify up to Passivhaus performance. A high performance insulated envelope has been designed to achieve U-values of 0.15W/m2K and lower. Airtightness has been given great thought in the development of system details, and the ease of onsite buildability ensures that an airtightness of 0.6 air changes per hour is much less prone to the challenges of traditional onsite construction processes.

A naturally breathable fabric of natural, recycled and waste materials is exceptional in the market with no moisture trapping man made materials such as petro-chemical based insulations and moisture resistant sheathing boards so common in modern 'environmentally sustainable' construction methods.

A range of simple low energy environmental management systems are available, offering background performance to provide a comfortable learning environment.



19 Classroom Type 01 Exploded Axonometric

8 why choose YSGOL

- Based on the award winning research project 'Ty Unnos', developed with woodland management charity Coed Cymru.
- Architect designed high quality, sustainable and flexible buildings for education use.
- Combines homegrown Welsh timber, rarely used in the construction industry, with local, natural and recycled sustainable materials and products.
- A simple and standardised kit of components, prefabricated offsite and quickly and easily assembled on site.
- Lightweight and low impact foundations allow the building to 'touch lightly' on the site and enable complete 'reversibility'.
- A high performance insulated envelope exceeds Building Regulations and in combination with renewable systems offers potential for a fully autonomous building solution.
- High performance windows and doors are designed to maximise solar gains and natural daylighting.

- Poor
- Fair
- Good

Analysis Of Benefits	Portakabin or similar	YSGOL	Traditional onsite construction
COST			
Capital cost	●	●	●
Running costs	●	●	●
Residual value	●	●	●
PERFORMANCE			
Thermal performance	●	●	●
Natural light	●	●	●
Natural ventilation	●	●	●
Healthy learning environment	●	●	●
DESIGN			
Adaptability	●	●	●
Flexibility	●	●	●
Designed for purpose	●	●	●
ENVIRONMENTAL SUSTAINABILITY			
Reversibility of site	●	●	●
Construction associated waste	●	●	●
Locally sourced	●	●	●
Natural or recycled materials	●	●	●
Embodied energy	●	●	●
Recoverability at end of life	●	●	●
CONSTRUCTION			
Speed of construction	●	●	●
Construction impact on site	●	●	●
Reversibility of site at end of life	●	●	●

9 some examples...

YSGOL represents a new collaborative venture for the project partners. Since its inception as a research and development project, the system components have been detailed in a wide range of applications from a compact rural studio to a large span forestry visitor centre.

The following portfolio shows a brief selection of public and education projects realised using the Tŷ Unnos construction components. A selection of further projects is available on request.



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Design / Manufacturing Team

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Environmental Resource Centre

Design Research Unit Wales
G Adams Construction
Kenton Jones Joinery

2

Royal Welsh Pavilion

Davies Sutton Architects
Mann Williams Engineering
Maxiom Ltd
Kenton Jones Joinery

3

Canolfan Tyfu

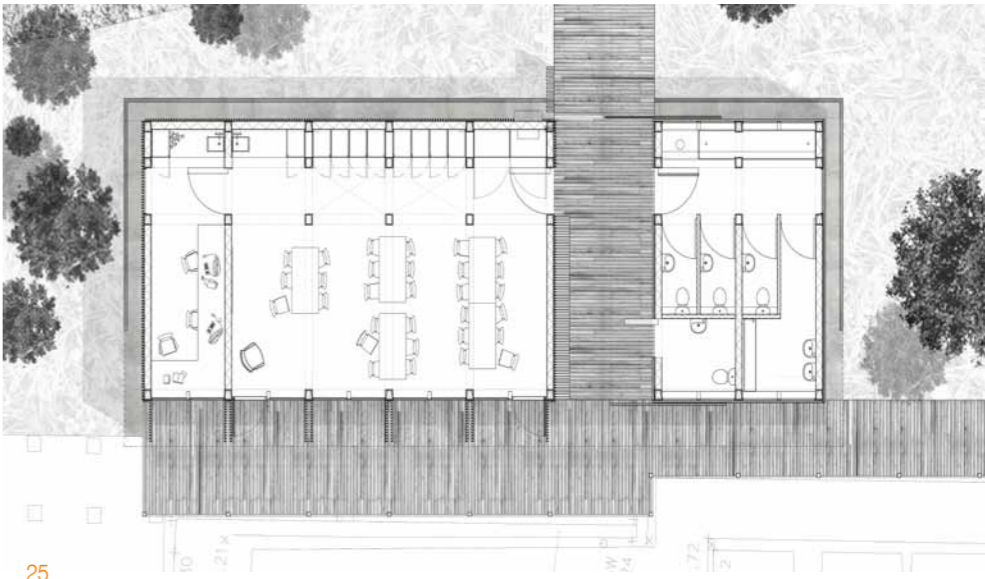
Hughes Architects
Mann Williams Engineering
Elements Europe
Kenton Jones Joinery

Environmental Resource Centre

Architect: Design Research Unit Wales
 Location: Ebbw Vale, Blaenau Gwent
 Client: Blaenau Gwent County Borough Council
 Engineer: Cowley Timberwork
 Contractor: G Adams Construction
 Manufacturer: Cowley Timberwork
 Status: Completed 2010

The Environmental Resource Centre at 'The Works' regeneration site in Ebbw Vale was the first commercially completed project to use the award winning Tŷ Unnos construction components, prefabricated for onsite assembly. Located on an ecologically rich site next to the former Steelwork Pumphouse cooling ponds, the centre provides educational facilities to allow local school children and the community to explore the heritage and ecology of the former industrial site.

The simple rectilinear classroom combines portal frames of standard sized box section components as a simple frame for ground floor, posts and roof with Structurally Insulated Panels (SIPs) as the infill for floor, walls and roof. Assembled on site from prefabricated components the centre is designed to achieve a 60% reduction over Building Regulations through the design of a building envelope which provides high U-values and air tightness in parallel with an intelligent response to site, encouraging solar gains during the winter months, and a state of the art heating and ventilation system.



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Royal Welsh Pavilion



Architect: Davies Sutton Architects
Location: RWAS, Builth Wells
Client: Coed Cymru
Engineer: Mann Williams
Contractor: Maxiom Ltd
Manufacturer: Kenton Jones Joinery
Status: Completed 2015

The 1.5 storey Royal Welsh Pavilion at the Royal Welsh Showground provides a new show stand for the woodland charity Coed Cymru. It is constructed as a showcase for Welsh timber products aimed at encouraging the growth of sustainable Welsh forestry and the use of Welsh timber for high value construction purposes.

The latest iteration of the system combines a post and beam frame with an advanced prefabricated panel system of Welsh softwood, recycled cellulose insulation and breathable sheathing products. In addition, windows, doors, stairs, balustrades, internal and external finishes are manufactured using locally sourced timber.

The system enabled a short period of construction on site with the main building being assembled on precast footings in just one day. The temporary building has been designed for full recover-ability at the end of its 6 year lease.



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Canolfan Tyfu

Architect: Hughes Architects
Location: Llanarthne, Carmarthenshire
Client: Growing the Future project @ National Botanic Garden of Wales
Engineer: Burroughs
Contractor: Elements Europe
Manufacturer: Kenton Jones
Status: Completed 2012

Growing the Future project based at The National Botanic Garden of Wales built their new teaching facility, Canolfan Tyfu, using the Tŷ Unnos system. Situated within the Garden the building has a 19m x 6.6m footprint and houses a large dual entrance foyer, two wet rooms and two large classrooms with walk in storage facilities.

It is constructed from home-grown Sitka Spruce box beams, ladder beams and joists, with horizontal and vertical Welsh Larch cladding in both natural and scorched finishes. Large tri-fold timber doors provide secondary access to both classrooms. Insulation is provided by Warmcel® recycled newspaper. The roof sheeting was supplied by TATA steel and is a profiled metal sheet cladding manufactured in Wales.

Box beams were assembled into portal frames and fitted with metal feet in the factory prior to transportation - on site they were craned into position and bolted to small concrete pad foundations. Waterproof membrane was factory fitted to the floor, wall and ceiling 'open structural panels' enabling fast and weather-proof construction onsite.



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10 Contact

For further information please visit;

<http://www.davies-sutton.co.uk>

<http://www.coedcymru.org.uk/tyunnos.html>

<http://www.mannwilliams.co.uk>

and Contact;

Rob Thomas

Davies Sutton Architects

t 02920 66 44 55

e rob.thomas@davies-sutton.co.uk

w www.davies-sutton.co.uk

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02, 03, Forestry Commission Picture Library

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26, 27 Williams, S. (www.ambientcapture.co.uk)