Work Packages & Organisation Chart

WP0 Built Environment Programme Management

Chair Prof Phil Jones, Cardiff University

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|--|-----|
| <i>WP1 Sustainable Building Envelopes</i> | - |
| <i>WP2 Lighting</i> Chair Prof Paul Rees, Swansea University | - |
| WP3 Use of timber in building construction | - |
| WP4 Low carbon design solutions Chair Dr Wayne Forster Cardiff University | - |
| WP5 Urban scale demand and supply Chair Simon Lannon Cardiff University | |
| WP6 Monitoring the performance of low carbon technologies Chair Prof Chris Tweed, Cardiff University | - |
| WP7 Innovation, technology deployment and market development: Chair Prof Malcolm Eames, Cardiff University | |

LCBE Work Package 4: Low Carbon Design Solutions

Design of Low & Zero Carbon Buildings

- To produce in collaboration with the whole supply chain, design guidance and ۲ standard proof tested zero-carbon solutions for a range of building types.
- Building types selected in response to the planned investment in the next ulletgeneration of public buildings.



HOUSING

EDUCATION



Available online at http://orca.cf.ac.uk/27168/

LCBE Work Package 4: Low Carbon Design Solutions Design of Low & Zero Carbon Buildings - OUTPUTS

HOUSING

• Dwelling Case Study Book

Available online at http://orca.cf.ac.uk/27168/



- Dwelling Typical Details paper
- Fabric & Systems report
- Design concept proposals
- 'Dwelling' conference 14th October 2011

EDUCATION

• Learning Case Study Book



Cost Report

Available online soon

- 'Low Carbon Learning: Lessons from Practice' conference 5th September 2013
- Achievements: 9 companies assisted, 2 Research and Development Collaborations, 2 Processes Improved, over 100 delegates involved, Low Carbon design advice given to local Authorities across Wales (ongoing involvement), lectures & tutorials given to students of BSc & MSc at Welsh School of Architecture

Case Studies: Housing

From Wales and UK over the last 5 years. Examplar housing schemes discussed:

Mariner's Quay, Old Town Dock, Newport

Chapel Close, St Athan, Vale of Glamorgan

Future Homes Visitor Centre, Ebbw Vale Passive house

Retrofit for the Future, The Turnstiles, Newport



Ty Unnos Longhouse, The Works Ebbw Vale

Design Research Unit Wales

Blaenau Gwent County Borough Council

Brief

Comply with Works design code

Code for Sustainable Homes Level 5

Use local sustainable materials/ supply chain

Passivhaus performance <15KWh/m2/yr space heating

Innovative systems and energy conservation

Meet DQR requirements







Ground floor plan



First floor plan





KEY

- Dark grey steel standing seam roof
 Vertical Welsh chestnut cladding
 Triple glazed Welsh timber framed windows
 Render (colour as illustrated)
 Walkway canopy/ solar shading
 Zone for photovoltaics and solar water panels

South elevation



KEY

- Dark grey steel standing seam roof
 Vertical Welsh chestnut cladding
 Triple glazed Welsh timber framed windows
 Render (colour as illustrated)









17.78

Energy and environment



Vision: local materials

Main contractor: Mechanical sub-contractor: Electrical sub-contractor: Domestic Water: Foundation concrete: Ground floor screed: Ty Unnos manufacturer: Steel fabricators: Windows, doors & stairs: Ironmongery: Aluminium Flashings: Insulation, membranes, pressure test: Ground floor internal Slate: External Render: External chestnut cladding: Roofing sub-contractor: Solar Panels: Wall tiling: Radiators: External floor slate: Scaffolding: **Building Supplies:**

Fencing:

Plant Hire:

Temp fencing:

G Adams Construction Ltd Micaul Solar (Cwmbran) M Moon Electrical (Tredegar) N.Perret (Cwm) Tarmac (Ebww Vale) Phil Harris (Abertillery) Kenton Jones (Welshpool) Rokel Engineering (Merthyr) Vintage Joinery (Cwmtillery) Locktech (Swansea) Euroclad (Cardiff)

Pen-y-Coed Warmcel (Welshpool)

Ground floor external insulation: Rockwool (Pencoed) Welsh slate from Mandarin Stone First floor external woodfibre insulation: TyMawr (Brecon) Specialist External Renders Ltd Wentwood Timber (Wentwood) First floor sycamore supplier: Wentwood Timber (Wentwood) Corus Colourcoat Urban (Shotton) Filsol Solar Panels (Newport) W.Palfrey Tiling Ltd (Tredegar) Quinn radiators (Newport) Cerrig (Pwllheli) Shadow (Bargoed) Robert Price (Ebbw Vale), Gwent Building Supplies (Tredegar), Travis Perkins (Ebbw Vale), Sheffield Insulation (Cardiff) Price Landscapes (Merthyr) CBL (Pyle), U Hire (Ebbw Vale) Heras (Cwmbran) Kabin Hire (Caerphilly) Welfare and stores:

Vision: local materials

-Ty Unnos:

- Uses local materials in a locally developed construction system
- Adds value to a Welsh raw material
- Develops local supply chain and skills
- Regional house types derived from traditional Welsh precedent

Construction: Ty Unnos

Ty Unnos: box beam

Mariners Quay, Old Town Dock, Newport **Code 5 Affordable Housing**

Speaker: Bernadette Kinsella

Powell Dobson Architects

HOARE

ANTHONY JELLARD ASSOCIATES

Key Design Principles: Site

- Fabric first
- Southerly orientation passive solar gains
- District energy centre
- Urban design principles equally as valuable
- Narrow, double fronted site mews
- Visual and physical permeability

APARTMENTS SERVICES ZONE

ENERGY CENTRE

Code for Sustainable Homes: Overview

| Percentage better than Part L1A 2006 | | | |
|--------------------------------------|------------------|--|--|
| 1 (★) | 10 % | | |
| 2 (★ ★) | 18 % | | |
| 3 (★ ★ ★) | 25 % | | |
| 4 (* * * *) | 44 % | | |
| 5 (* * * * *) | 100 % | | |
| 6 (* * * * * *) | zero carbon home | | |

6 mandatory requirements

SUSTAINABLE

- Credits cover the following assessment themes:
 - Energy

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- Water
- Waste
- Materials
- Surface drainage
- Ecology
- Pollution

Code Level 5 Requirements

Minimum Requirements:

Besides all the mandatory requirements related to the CSH, there are extra minimum requirements

Category 1 – Energy & CO2 Emissions

Energy efficiency measures

BUILDING ENVELOPE

BUILDING SERVICES

- External Wall **U-value = 0.15 W/m².K**
- Better Party Wall Construction
- Window **U-value = 0.80 W/m²K**
- Solar transmittance **g** = **0.5**
- Timber-frame Windows
- Glazed door U-value: 1.50 W/m².K
- Solid door U-value: 1.00 W/m².K
- Low Global thermal bridges: External insulation?
- Air Permeability = 2.6 m³/(h.m²) at 50 Pa (tested)

- Mechanical ventilation with heat recovery (HR efficiency > 80%)
- Low fan electricity consumption (Specific Fan Power < 1.0 W/l/s)
- Residences linked to
 Community Heating System
- 100% Fixed Energy Efficient Lighting Fittings

Low or Zero Carbon Technologies

How did we design to achieve Code 5?

Designing Low Carbon Homes: Lessons from Practice

A conference at the Welsh School of Architecture Friday 14th October 2011

'Designing Low Carbon Homes: Lessons from Practice' will focus on the definitions, standards and challenges of delivering zero carbon homes in Wales. Since the announcement of the zero carbon ambition in 2008, the construction industry has seen a severe downturn that has impacted on all sectors. This conference will attempt to address the delivery of zero carbon housing in this challenging economic climate. As part of an ongoing project to provide guidance to the industry, three key questions will be posed:

- How should we be building?
- To what standard?
- At what cost?

The conference will disseminate the early findings of the Low Carbon Research Institute's Low Carbon Built Environment programme work package, 'Design of Low/Zero Carbon Buildings'.

General Lessons: Dwelling

- Building form, orientation, passive design and fabric first will do the hard work
- Strong partnerships between contractor, sub-contractor, design team and client, including code assessor are critical to a good output
- Aim for a high level of airtightness use of prefabrication or MMC may assist in achieving effective results
- Drive demand for low carbon homes market as a benefit, i.e. reduced bills, guaranteed capped energy payments.
- Incorporate Soft landings process to handover to household user, ensuring they are fully aware of how to live with low carbon technologies
- Don't rely on just meeting minimum Building Regulations
- RIBA Plan of Work 2013 lack of emphasis on sustainability checkpoints
- Cost & energy use not the only marker for a successful sustainable housing scheme

Case Studies: Education

From Wales and UK over the last 5 years. Examplar schools discussed:

earnino

Coleg Cymunedol Y Dderwen, Bridgend; new build secondary Blaenavon Community Campus; new build primary Taf Ely Learning Campus; new build tertiary college All Saints Academy Plymouth; retrofit and extend secondary

Passivhaus schools Oakmeadow School, Wolverhampton; new build primary Hauptschule, Klaus, Austria; new build secondary

Standardised school 'The Paxton' by Scape; model for primary with precendent new build primary's: Kingsmead, Cheshire Yynysowen School, Merthyr Tydfil

Gateway to the Valleys: Coleg Cymunedol y Dderwen Scott Brownrigg

Achieved BREEAM 'Outstanding' (score 89.82%)

School Brief:

1570 students (including SEN) with room to expand further if necessary

6 colleges within the school

14,450sqm

ICT rich learning

strong focus on teaching, learning and high achievement

a broad and innovative curriculum

an aspirational environment

school provision part of an integrated service to students and families

Procurement:

selected via PQQ

£39m project cost

appointed by LA for full services

NEC3 contract – option c

support funding submission

interviewed contractors - SEWSCAP

novated to contractor

- Colleges arranged along an internal street
- Classrooms facing East and West
- Upper street open to ground floor
- Localised M&E per college

holistic approach to designing for low carbon

reduce in use carbon - passive design

reduce water use age

use sustainable construction materials

adaptable for the future

provide positive contribution to the community

target **local** spend both pre and during construction

provide a template that can be built on for the **future**

achieve **BREEAM excellent target outstanding** through *considered* sustainable design

passive design

natural Vent

maximising natural daylight

orientation

overhangs/ recessed reveals

solar Control

20% Improvement on U-Values

air Permeability 5 m3/m2/hr @50Pa

exposed thermal Mass

active solutions

biomass boiler

photovoltaic's

solar hot water

rainwater Harvesting

underfloor heating

CHP connection

cashless systems

education and culture

solar hot water system

rainwater harvesting system

meter and monitor

electricity

gas

biomass

combined heat & power (CHP)

potable water

rainwater harvesting

high energy uses

BREEAM

89.82%

monitoring tool

DTM

materials - concrete v steel

= Social

= Economic

value engineering

| breeam | The Code for Sustainable Buildings |
|--|--|
| Th | is is to certify that |
| Coleg Cymu Heol-yr- Bridge | ınedol Y Dderwen, Ysgol, Tondu, nd, CF32 9EL |
| has achieved a score | of 89.82%, and a BREEAM rating of |
| OUT | STANDING |
| This Design Stage assessment was can Robust Hoff, Supres on Sector 44 Once Lis | ied out under the 2009 version of BREEAM Education |
| Elaine Veaudour | Arup |
| Licensed Assessor | On behalf of |
| Bridgend County Borough Council | Scott Brownrigg |
| | |
| Arup M & E Engineer | Leadbitter Group Main Contractor |
| Davis Lanadon | Jubb Consulting Engineers Limited |
| Projector Manager | Stuctural Engineer |
| Davis Langdon Cost Consutant | |
| Certificate Reference: A/EDU-U027-1 | Jan John and |
| breglobal | This perfords weating the property of RVS Oxfair LM and a laward acquest to some and conditions. The lawar produced on this takes of data weights by the laward BVEEAW to induce the analysis of the source and the source of BVEEAW to induce the analysis of the source analysis of the RVEEAW to the analysis of the source analysis of the RVEEAW to the analysis of the source analysis of the RVEEAW to the source and the source analysis of the RVEEAW to the source and the source analysis of the RVEEAW to the source analysis of the RVEEAW to the source and the source analysis of the RVEEAW to the source and the source analysis of the RVEEAW to the source and the source analysis of the RVEEAW to the source and the source analysis of the RVEEAW to the source and the source analysis of the RVEEAW to the source and the source and the source analysis of the RVEEAW to the source and the source analysis of the RVEEAW to the source and the source and the source analysis of the RVEEAW to the source and the source and the source and the RVEEAW to the source and the source and the source and the RVEEAW to the source and the source and the source and the RVEEAW to the source and the source and the source and the RVEEAW to the source and the source and the source and the RVEEAW to the source and the source and the source and the RVEEAW to the source and the sourc |

general successes

lessons taken forward

on time

on **budget**

BRE BREEAM sustainable education building of the year **award** 2013

BREEAM 'outstanding'

low carbon

collaborative working

united community school

early stakeholder engagement

agree BIM protocols/ execution plan & M&E scope

early BREEAM Assessor appointment

agree appropriate **design principles** at the outset

Basic principles of Passivhaus

- improve the fabric eliminate thermal bridging, increase airtightness and window specification
- use MHVR to allow sufficient ventilation whilst avoiding loss of heat in winter
- get the orientation and form working together to maximise and control solar gain, improve daylighting and enable natural ventilation and night cooling in summer
- make heating efficient and eliminate need for cooling
- use PHPP to model and test achieve heating of 15kWh/sqm and total primary energy of 120kWh/sqm
- enable easy and intuitive controls systems
- keep things simple

= make the basic architecture & building do all the hard work!

Passivhaus standards

Passivhaus: Oakmeadow Primary School, Wolverhampton

2 x 65kW boilers 25kW peak heat demand 5x oversized!

general successes

on **time**/on **budget** & no more than a typical primary school build

One of the first Passivhaus schools to be built in the UK

Early integration of services

Pushes energy targets harder than previously built St Luke's Primary

Early **collaborative** working – integrated total design team commitment

Focussed workshops with all key subcontractors

School is performing as predicted within energy targets

lessons taken forward

Soft landings handover and first year operation (self funded)

Engaging with school leadership groups on operational issues

User guides and presentations ensuring ongoing correct building use

Engaging the pupil council in energy issues

Tailor-made package for kitchen use and appliances

Make allowance for user intervention

Keep controls simple and user friendly

RI LOW CARBON RESEARCH INSTITUTE

LCBE | Low Carbon Built Environment

Low Carbon Learning Lessons from Practice

Work Package 4: Education buildings and the low carbon agenda Symposium 5th September 2013 at WISE, Machynlleth

9.30am Registration

10.00am

10.30am

11.15am

12.15pm

from 2.15pm

environmental management

officer (book in

advance before 2nd September)

One to one booked sessions

with LCRI

Welcome & Introduction to Work Package 4 Policy and Future trends

Coleg Cymunedol Y Dderwen Design, Procurement and Engagement Scott Brownrigg

Oakmeadow Primary Passivhaus Schools in practice Architype

12.00pm coffee break

> Ynysowen and Kingsmead Developing a standardised approach White Design

mq00. Introduction to WEST and LCRI Environmental Management officer

1.15pm Lunch

5.00pm Close

2.15pm Discussion Workshops: 1 - Achieving the Energy Obligations on Site 2 - Lessons learnt: Passivhaus vs BREEAM 3 - Retrofitting schools: a realistic choice?

3.15pm coffee

3.30pm WISE Building Tour

4.30pm Discussion & feedback

Workshop 1: Achieving the energy obligations on site & the role of the SME

Leadbitter Examining the realities, pitfalls & successes of meeting low carbon aspirations on site & exploring the opportunities and barriers for local enterprises

Seconds, Fravel Oction

Workshop 2: Lessons Learnt -Passivhaus vs BREEAM Architype & Scott Brownrigg A comparison of the procurement, targets & outcomes including a debate about the realities & costs associated with each different approach

Workshop 3: Retrofitting Schools -A realistic choice? White Design A look at how retrofitted & extended schools must become a viable option in

towards low carbon targets

allowing the existing stock to contribute

Register online & choose workshop at: http://lcbe.cardiff.ac.uk/events/low-carbon-learning-lessons-from-practice/ or contact Amy Cowan t: 02920 875980 e: cowana@cardiff.ac.uk

General Lessons:

- Building form, orientation and good design will do the hard work
- Early engagement of client and design teams critical to understanding of aspirations throughout process
- Soft landings process normally taken on by contractors consideration & cost should be given from very start of project – include FM team
- Importance of identifying roles & responsibilities
- **Prioritise energy use targets** safeguard and use in conjunction with wider benefits (BREEAM & PH combined?)
- Consider adapting standards to incorporate wider benefits
- RIBA Plan of Work 2013 lack of emphasis on sustainability checkpoints
- Cost & energy use not the only marker for a successful sustainable school
- Interrogate standards and consider a flexible approach to benchmark standards, e.g. combination of PH & BREEAM requirements, to suit your school's long term needs

What about Cost??

•Safeguard budget for improved fabric against life cycle savings

•Low carbon aspirations to be 'locked-in' to contract - not becoming optional in value engineering processes

•Is the government's baseline £1400m2 realistic?

•Case study schools approx £1750-£1800m2

•Further investigation in to cost ongoing

•Need contractors and client teams to be open and share knowledge about actual costs

Process map – draft proposal

Locking in Low Carbon Design - process map Identifies Rollings

| DEFINE ASPIRATIONS for a low carbon school | |
|---|--|
| Our School | Teaching spaces comfortable and conducive to learning |
| offers excellent | School premises actively foster respect for ecology. |
| opportunities for all users | Buildings and grounds as a direct learning tool. |
| | School is a Low Carbon Beacon for community. |
| Dur School | Beneficial natural systems are intelligently exploited. |
| is efficient to run. | Efficient planning and zoning of school departments |
| | Intuitive simplicity for all users |
| | Clear Facilities Management handover. |
| ur School | Exploit existing assets of the site/location. |
| | Exploit any qualities of existing building stock. |
| offers good value. | Limit waste and repetition in design and construction |
| | Deliver through efficient construction processes. |
| | Programme and processes minimise school disruption. |
| Our School | School premises reponsive to future climate changes. |
| is future proofed. | Reponsive to future technology and innovation trends. |
| | Future demographic and socio -economic trends considered |

efine Aspirations' Case Study Example: Plymouth All Saints Acad

Define Approton: Care Daty Example: Pymouth AI Swith Adatmy The Courty Count was envised a capital handing grint and a to di a pathway for providing facilities if for 21st century learners. Cherr Brinking at the strategic level enabled the level to subquart their label approximate through the enabled of the process. The strategic celebrics defined by Low Caboo was, cub a coblering group clause for exaiting assets and using table: enhancements to exploit natural systems. The restricted barget focused commu-serers approximate to where mail mapset adult and systems. The restricted barget focused commu-serers approximate to where mail mapset.

The snamples given are solected from case studies within the poids. They illustrate projects that have successfully defined and sortiened appirations and passeducers throughout design, propresent, pontroution and use

Part L overview

et Plan DOVING. 205 ahigy ious Post Oc-

sity matrix

ustainable &

| w carbon oriteria: | PRIORITIZE ASPIRATIONS using feasibility studies & sustainability tools | |
|---|---|--|
| propriate internal air temperature regulated passively ool tems natural verification measuring good air quality that divergets to temperating spaces. desistanding of natural systems and empathy with the natural world medium tests around sustainable building technologies and combiniding medium tests around sustainable building technologies and combinident institution tests around nutrient systems working with nature releformstee learning through use and searcrease of building uncer of draft and cardinateding for what we | Building Regulations Part Loven Site Ecological Assessment Curriculum Links opportunities SS-Ed programmes (Sastanable Environmental Education) Community Engagement Plan | |
| ading fadio: maintains control tevels with maximum efficiency assive design principies to maintain control tevels for copture, wind copture and preview thin reserving. SUGS addings used effectively in response to sarping distributify use patterns ubler functionality of building between making then covious to users are startior transvessite in their advise school machine in a certain the starting the school active machine in a certain the school active the school machine in a certain the school active the pathween miniment to is goin cognary minime with pathweet pathers | Passwhaws Accreditation BREEPAM target and overview Local employment targets Draft Handover Strategy Draft Maintenance Strategy | |
| p into community infrastructure and local employment askade site orientation; views, local micro-climate, etc. analyse site orientation; views, local micro-climate, etc. analyse site of the site of the site of the site of the site of the askade building block. Staticityphenmion/oricon-intertients for recent/registe attential specific defined with comprocess-intertients for recent/registe attential specific pool faint communication (BM) attential specified for backtere employee you building attention within a specified for backtere employeed attention methods tocks at the procision and watter management - 4de construction and pre-empresent skuldowshatedsated paramentg based attenues statucol categories and usage | Conclusions from previous Post cograncy Assessment Sith Feasibility Study Existing building muselmcycle feasibility study Local sourcing targets Refindli Improvement target Design Team responsibility matt | |
| sign for disessembly and end of Alte musehexycle oportance of lurge trees and veryotation recognised in landscape shratboy the searchly designed in the passive coordina shratboy. You changing climate than IT capacities and service provision requirements considered bacadonal transformation, funding and management changes reviewed wing capacity for environ in accommodate capandrag local population | Embodied CO2e Assessment Draft Operational Strategy Site Waste Management Largets Life Oycle Assessment (LCA) | |

Thiostise Againstein Case Darby Example: Tat Ely Campun, Colog Morganney Building on part aspecterol, the cologo commissions were keen to use IPCAM as a transmers for ensure to extern automate, and made to cologo commissions were keen to use IPCAM as a transmers for antarpo, decisions. One Intervention as the ElyC Green Golds goodCaston target of A A + and go chose for protritator in the material geodication Astitionaly, ICO 1400 was used to control the wide impact of the praject potentiator. Intervention and application Astitionaly, ICO 1400 was used to control the wide impact of the praject potentiator in the material geodication Astitionaly, ICO 1400 was used to control the wide impact of the praject

CONFIRM COMMITMENT n procurement arrangment

most brief that locks in low carbon

tipls against set criteria.

SAFEGUARD MEASURES in detailed and technical design stages

contractor and FM team to man expirations. Clearly specify aspects of tential to meet sustainability onteria within ste practice and handover requirements. Heview all bidder's sustainability creden-ing and monitoring low carbon measures

Example Colleg Cymwredd 7 Edwren Baldieg Internation Modellig (Marsu ace by the desgn team from the cutet to existe matistic aniysis of chargens to goodclaufon anistic aniysis of chargens to goodclaufon for smale accurate solar studens and revolue the impact of any start solar studens and revolue the impact of any start solar model of dated therma anispita the anispital model of dated therma anispita to an start anispital control and anispita the anispital model of dated therma anispital to an anispital model of dated therma anispital to anispital model of dated therma anispital to an anispital model of the anispital contractors to meet sustainability control and the high degree of cost centainty.

Them expended bith Literature Canargin: Cold Madoria Primary School The architect augented using the Plausheum Standard as a meshod with low running colls. The PHPP acceleration aims to prove the PhPP acceleration aims to prove the new compliance with a set of orthonic, deliving a new Compliance with a set of orthonic, deliving a commitment backweing the PHPP langed. Columbodius was delivered auccessfully details contractioned as solitorized readors for the technical automatical science and by the columbodius and delivered the PHP langed. Columbodius auto delivered as solit andergin rundower to ensure I M contriued to assault the building in achimics flag controllar. ving its potential to achieve an energy efficient building Ensure subcontractors and suboleers a coordinated and compliant with sustaina bility strategy. Before making any chang the FM team and building users need to be in tune with the low carbon ethos. es to design or methods, consider wid implications on performance and su captured in initial aspirations, as well as engaged and informed to enable school to fulfill its potential to be low carbon.

NO 3 TODA

Example: Kingmead Primary School / Paxton The commissioning team for Kingsmead included a proactive and well-informed head teacher who recognised the key importance of the sustainabi-ity agenda in the curriculum and school management ethos. The new school building was used as a catalyst for this process, providing continuity from initial brief setting right through to operational school running. Its influence was feit on a micro to macro level with a host of POE studies. bringing the 'story' of kingsmead fullcircle. Its atest interation is in the design principles being adapted for standardisation by 'Sunesis'

tainability. Review measures through-out construction, to ensure the standards set are adhered to. manage this aspect of the build

team access to additional services liding workshops to set airtighness workion principles and agree line of onstruction site visits to for GA and roducing reports to support on-alti-decisions and inform wider team

UPDATE

MEAS

RES