

Future Works Housing Competition /

[J] - Kit house



▲ Barn on hill side at Blanaú Gwent

Cultural Significance

Successful building has through time responded to the people, their culture, the land and its climate. Modern housing development in Wales has virtually dismissed our unique cultural distinctiveness. Why can't our built environment enjoy the same recognition as our music and poetry? This is what we have sought to address in the design for the Welsh Passive House. Achieving a sustainable low energy dwelling should not be incompatible with the retention of our cultural identity.

Local Influences

We have drawn our inspiration from the agricultural buildings and cottages that are synonymous with the Welsh rural landscape. A great many examples still remain dotted around the semi-rural hinterland of Ebbw Vale. These strong silhouetted forms sit in opposition to the landscape and have a distinctive regionalism. Settlers, who generally worked in local quarries and mines, built up small holdings and began to practice farming. This development led to the dispersed settlement pattern seen in the Welsh landscape today. Out of these small holdings towns have grown, and this is the reference point for a modern interpretation of these structures to generate a vision for housing at the Works site at Ebbw Vale.



▲ Street elevational perspective

Semi Detached Form

The form is a simple, landscape-hugging slate and timber clad house, topped by a pitched roof also in slate. Within this very simple shape openings have been cut very minimally on the north face and more generously on the south .

Natural stone boundary walls, typical of the region, connect the building to the earth and integrate the facade of the building with the plot boundaries.

A semi-detached typology has been utilised to minimise the exposed external wall area. The result is a sympathetic solution which is also a familiar and popular consumer choice.

The form is then carved out to create sheltered sun terraces and entrance porches without comprising the overall integrity of the form.

Flexible Layout

The principles of the plan form for both plots are to provide an efficient layout that complies in all respects with the DQR whilst allowing the potential for reducing artificial lighting demand and maximising controlled passive solar heat gains in winter.

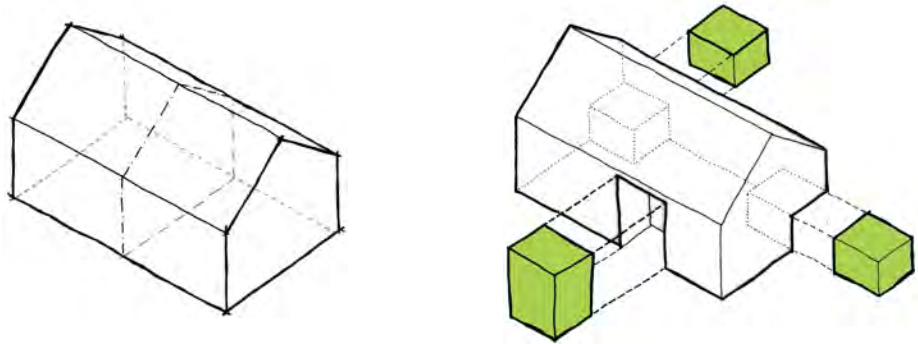
The staircase is located centrally in the house providing movement between the floors. It also creates a passive vent route with natural daylight entering the volume created at high level. Circulation routes are minimised so individual rooms can be made more generous.

Habitable rooms are located away from party walls to eliminate any possibility of noise issues. Bathrooms are placed on the north facing elevation so that the ground floor daytime living areas can face south towards the gardens which open up onto patios.

An open plan layout is provided in both houses to cater to the modern sensibility for the kitchen to act as the hub and focal point of the home. Also ample storage is provided to cater for the ever increasing need for families.

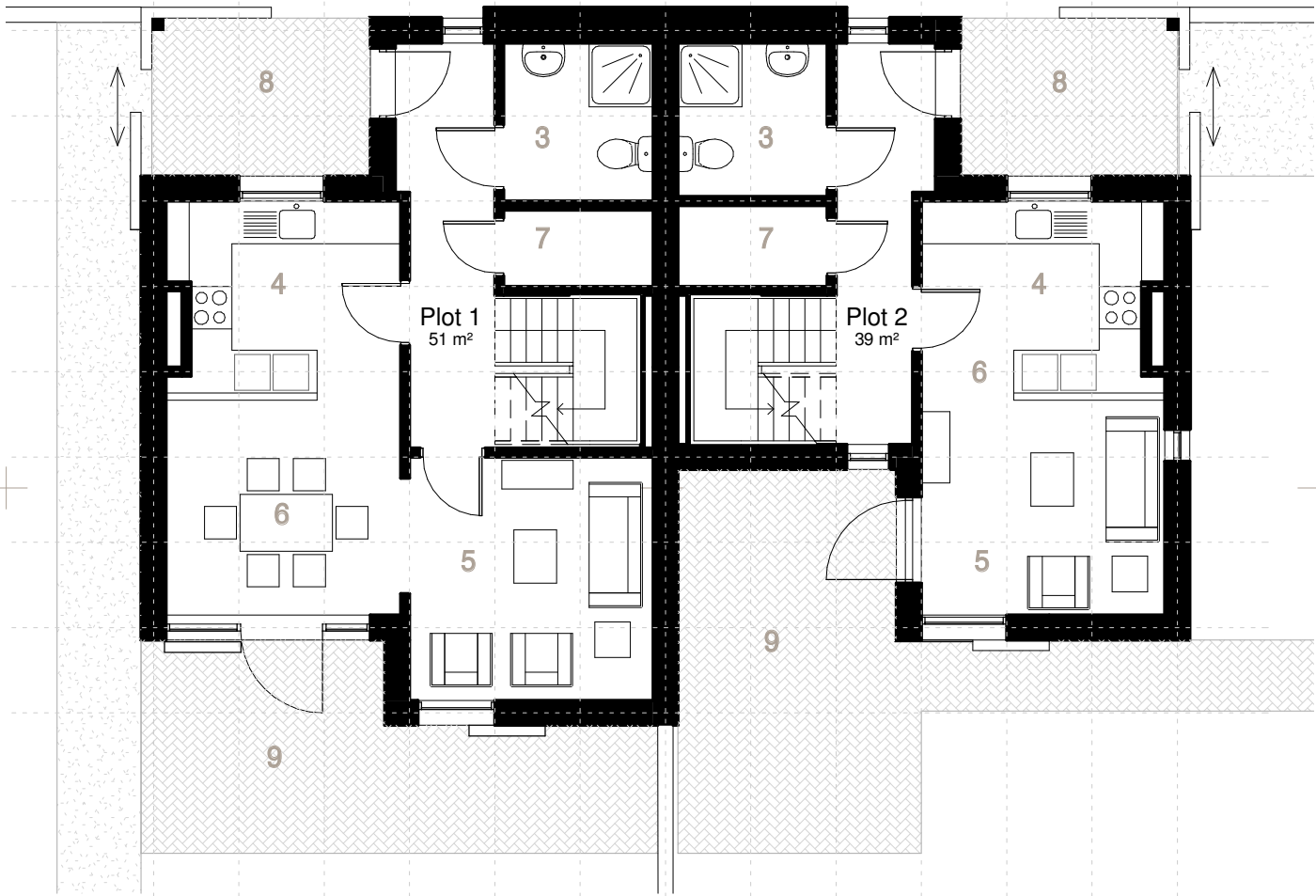
Plan Key

1. Bedroom
2. Bathroom
3. Ground floor shower and Wc
4. Kitchen
5. Living room
6. Dining
7. Storage
8. Entrance porch
9. Patio

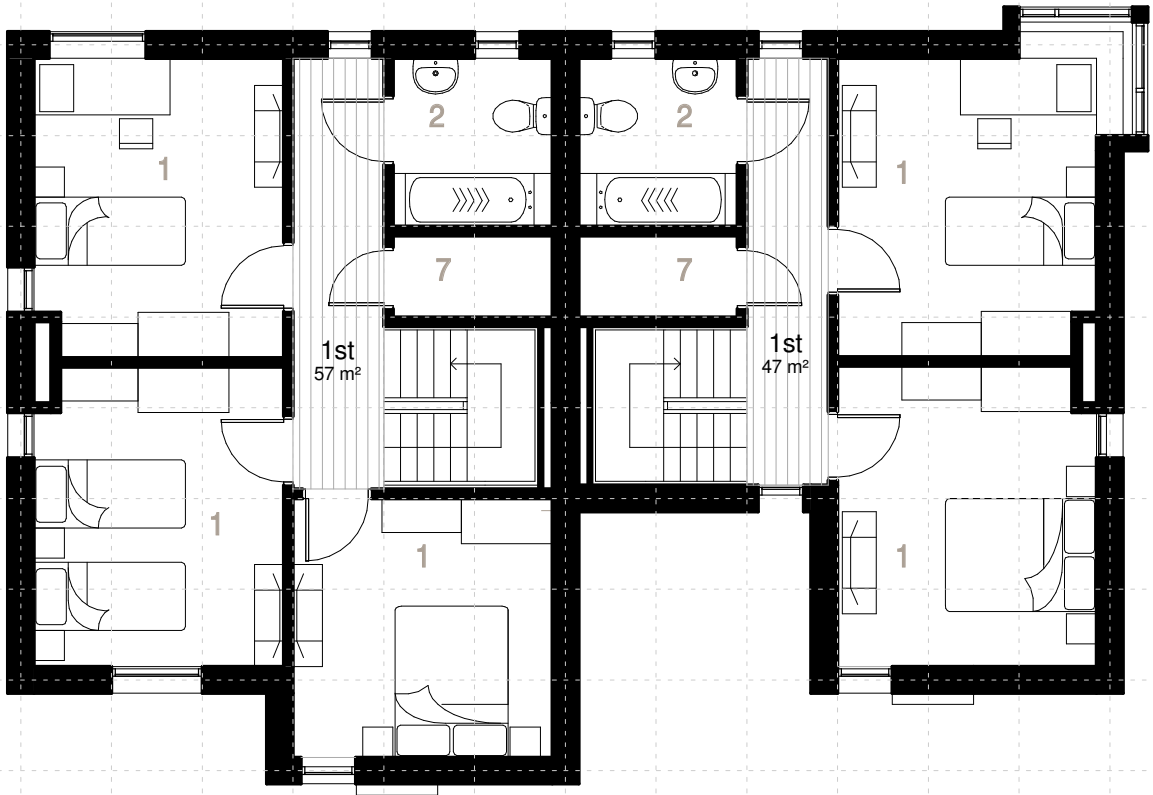


▲ Traditional form

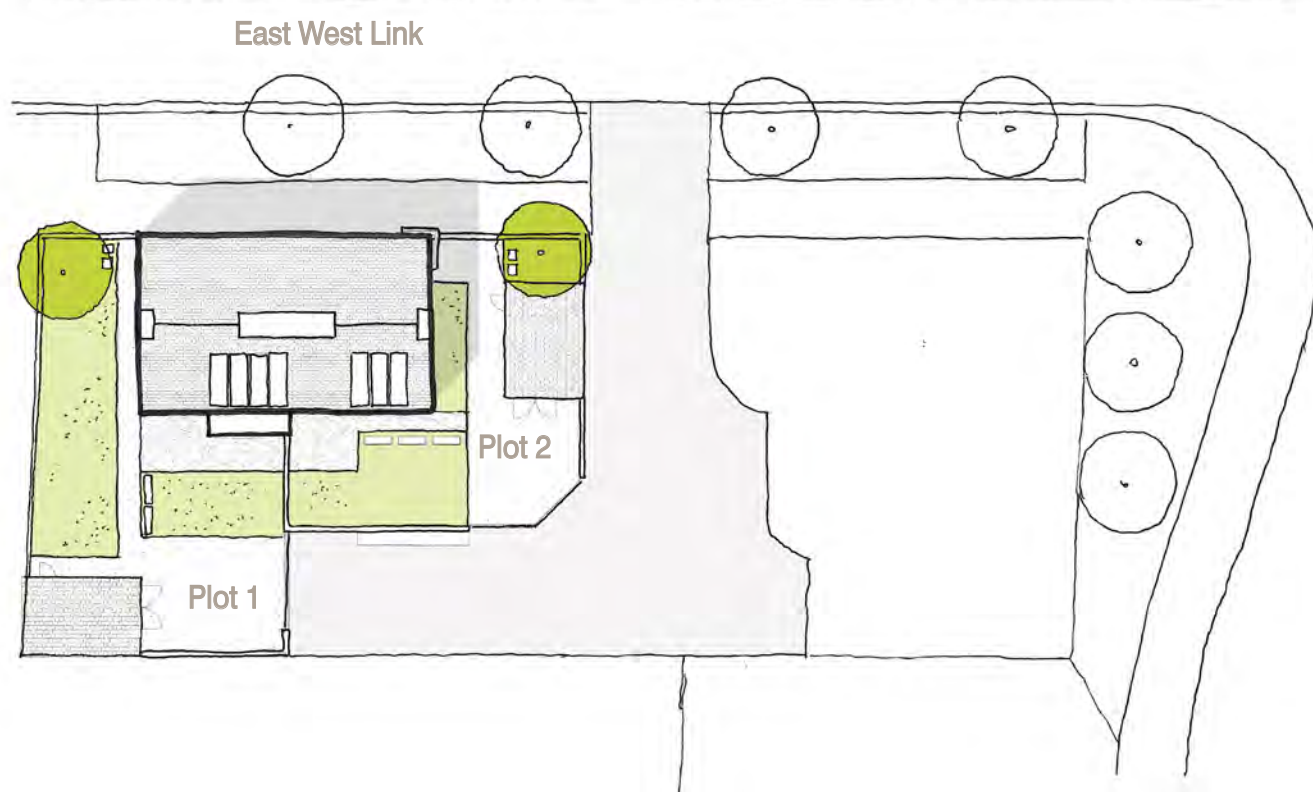
▲ Carved out space



▲ Ground Floor Plan



▲ First Floor Plan



Site Plan



Design for Shelter

The southern orientation of the gardens maximizes the opportunity to 'see' the sun all year round. It also ensures maximum output from the PV arrays and improves energy performance in winter months.

Soft landscaping and boundary walls provide maximum shelter from the chilling effects of winter air currents rising up through the valley from the south. Niches in the building form provide sheltered space where occupants can sit out and be protected from the wind.

Site Layout

Sited to form a strong urban edge along the East-West Link the dwellings hug close the boundary and so space is maximized for the rear gardens plots. A projecting bay window on plots addresses the vista from the corner square.

Private drives are located at the rear, with the 3-bed house providing 2 car spaces and the 2 bed space for one car. Single garages are provided for each plot where there is additional room for bicycle storage. Bins and recycling is located conveniently with space for rain water butts.



Garden Perspective

Elevations



▲ Street Elevation (North)



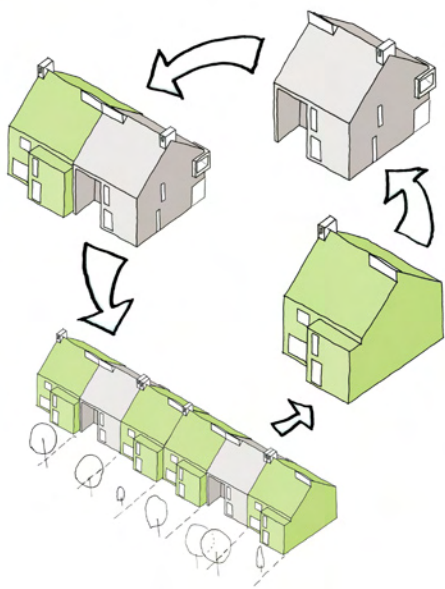
▲ Plot 2 Gable Elevation (East)



▲ Garden Elevation (South)



▲ Plot 1 Gable Elevation (West)



Expendability + Adaptability

The design can be easily adapted for single, semi-detached or terraced configurations. The typology is ideal for affordable housing being robust and adaptable. Land constraints and valley topography make semi-detached and terraced variations a necessity. Thus the units can be arranged for higher density or as standalone entities.

The form provides a visual continuity along the street frontage whilst an alternating rhythm between the open and closed parts provides privacy and daylight on the rear elevations.

The 2 bed starter home is smaller but has built in adaptability. The recessed sun terrace can be in filled to create two additional rooms. The roof pitch and stair position allow for a simple future loft conversion.



► Cutaway Section



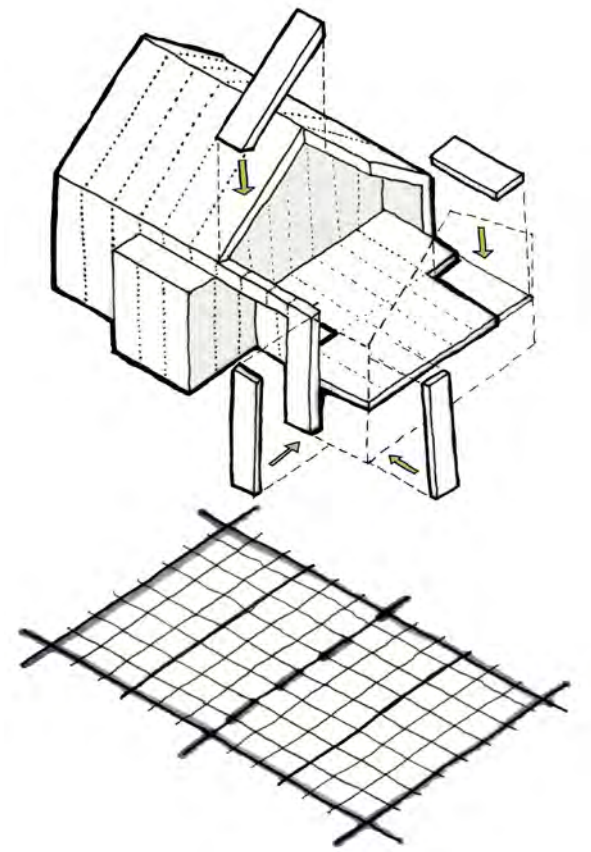
Modular Structure

It is proposed that the houses are to be constructed in timber most likely by a closed panel system such as Excel's Tradis system based in Rhymney, Gwent.

Embodying the principles of Modern Methods of Construction (MMC), the advantages of such a system is simple and rapid on-site erection; Factory controlled quality workmanship; Less wastage of raw material and the potential for a very high thermal and air tight fabric performance as required by the Passive House standard.

The design has been developed with buildability in mind. The structure has been set out to a regular module of 1200 and 600mm units. This further allows the ability for site waste to be reduced. Short spans are achieved throughout the plan a making for a more economic build.

The Tradis system utilises composite I beams formed into floor and wall cassettes offering a strong rigid frame that is also light and manoeuvrable during erection. Internally a service zone would also be incorporated to protect the cassettes from service penetrations.



Climatic Fabric Design - The Jacket

The design has been developed in direct response to the local climatic conditions. Although we do enjoy exceptions, Ebbw Vale is characterised by weather that is often cloudy, wet and windy with rain often driven in by the wind. Being an upland area it can experience harsh weather in winter and much lower temperatures than associated with the lowland areas of South Wales.

Thus the building has been conceived as a series of wrapping skins or jackets akin to the technology associated with camping and hiking jackets which provide protection during the deluge of an unexpected shower.

The construction is formed of a series of layers:

A vapour control layer allows internal moisture to migrate through the fabric whilst completely sealing the internal environment against unwanted heat losses. The target air tightness value is 2 m³/h/m³.

A super insulating layer wraps the entire envelope fully filling the timber frame structure with an average U value of 0.14 W/m²K. The timber structure is then sealed in a breathable membrane which prevents any possible water penetration into the structure.

The outer layers are a combination of timber and man-made slate rain-screens deflecting wind driven water.

◀ External wall section illustrating the proposed fabric built up to achieve an average u - value of 0.14 W/m²K.



Local Materials

Floors, walls and Roof structure: (Green Guide A)
Tradis factory produced wall panels, floor and roof
cassettes manufactured locally in Rhymney.



Timber Cladding: (Guide Guide A+)

The proposed use of home grown species of
sweet chestnut classed as durable allows the
timber to be left untreated to develop a silver grey
colour with minimal maintenance. The materis
grown and sourced in Wales via Coed Cymru.
Coed Cymru are a partnership of organisations
dedicated to bringing Welsh broadleaf woodlands
into sustainable management. It was founded in
1985 and established as a company limited by
guarantee and a charity in 1989.



Fibre Cement Slate: (Green Guide A Rated)

The Redland interlocking Cambrian Slates are
manufactured from recycled natural Welsh slate,
and have had their environmental credentials
officially recognised by the Building Research
Establishment (BRE) . Whilst resin-based slates
in general have a C-rating in the BRE’s Green
Guide to Specification, Redland Cambrians were
independently evaluated to achieve an A-rating in
2006. Recycled natural Welsh slate makes up 60%
of every Cambrian manufactured at Redland’s
plant in Wales itself.

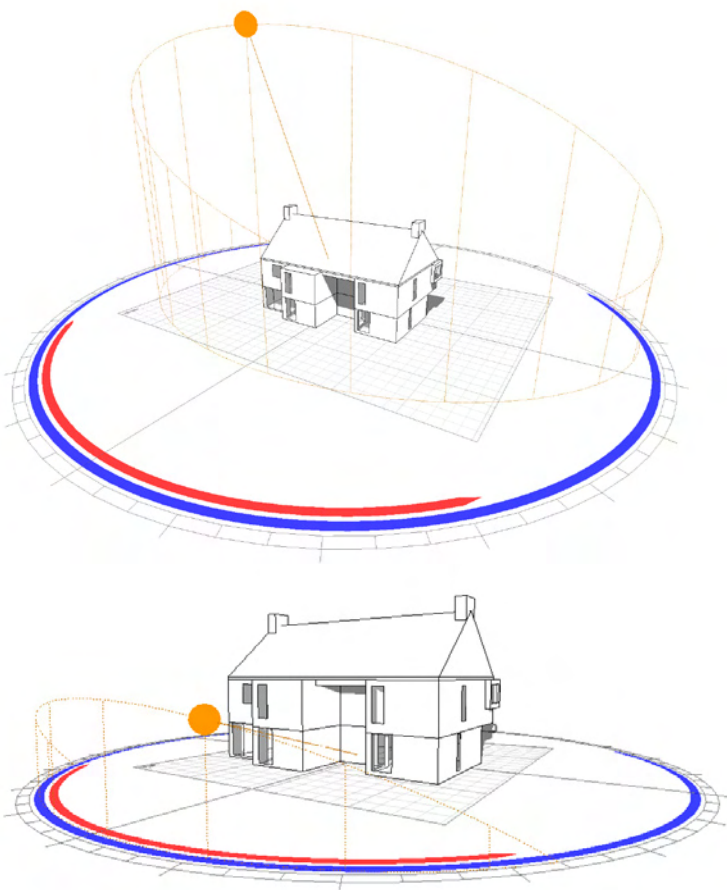
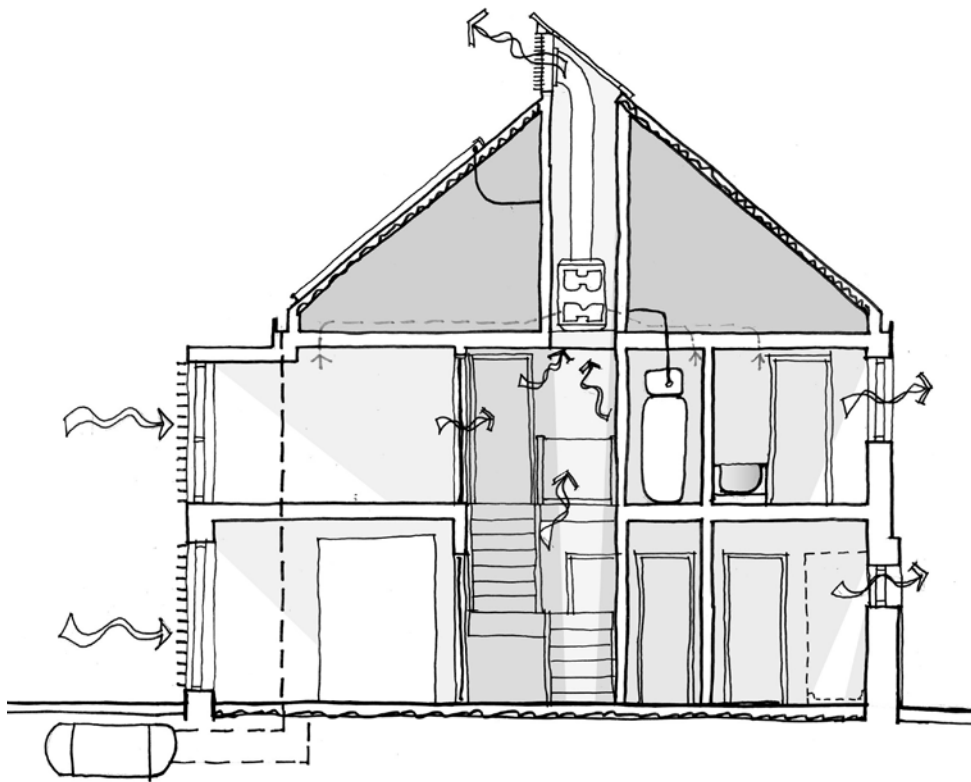
Code 5 Credit Summary

Shown below is the Code for Sustainable homes
CfSH pre-assessment summary with a breakdown
for each catagory.

Categories	Issue ID	Issue	Credits Available	Credits Assumed	Comments
Energy & CO2 Emissions	Ene 1	Dwelling Emission Rate (Mandatory)	15	14	100% improvement of DER over TER
	Ene 2	Building Fabric	2	2	Heat Loss Parameter (HLP) ≤ 1.10
	Ene 3	Internal Lighting	2	2	100% of Fixed internal fittings are dedicated energy efficient.
	Ene 4	Drying Space	1	1	6m+ external secured drying line proposed.
	Ene 5	Energy Labelled White Goods	2	2	A+ rated appliance proposed.
	Ene 6	External Lighting	2	2	Energy efficient lighting proposed for space and security lighting.
	Ene 7	Low Carbon Technologies (LZC)	2	2	Proposed 15% reduction in carbon emissions using PV.
	Ene 8	Cycle storage	2	2	Designated cycle storage area shown in the Garage.
	Ene 9	Home Office	1	1	Home office layout shown on the plans.
Water	Greywater recycling, Water reduction				
	Wat 1	Indoor water use (M)	5	5	equipment, Low flush WCs and Flow restrictors are proposed to be used
Materials	Wat 2	External water use	1	1	Rainwater harvesting along with Rainwater butt is proposed to meet the requirement
	Mat 1	Environmental impact of materials (M)	15	10	Green guide A+ rated specs with U-Values to achieve DER have been considered.
	Mat 2	Responsible sourcing of materials - basic building elements	6	3	List of potential suppliers and chain of supply identified.
Surface Water Run-off	Mat 3	Responsible sourcing of materials - finishing elements	3	2	List of potential suppliers and chain of supply identified.
	Sur 1	Management (M)	2	2	SUDs proposed to improve water quality of the rainwater discharge.
Waste	Sur 2	Flood Risk	2	2	Area located on low risk zone, however Flood risk assessment to be carried out for confirmation.
	Was 1	Recyclable & Non-recyclable household waste storage (M)	4	4	Required storage provided by Local authority collection scheme.
	Was 2	Construction Waste Management (M)	2	2	Credits awarded by default as the development is less than £300k.
Pollution	Was 3	Composting	1	1	Local authority kitchen waste collection system.
	Pol 1	GWP of insulants	1	1	Insulating material to have < 5 GWP.
Health & Wellbeing	Pol 2	NOx emissions	3	3	Baxi Ecogen Mini CHP proposed with ≤40 NOx levels.
	Hea 1	Daylighting	3	3	Required Average Daylight factor achieved.
	Hea 2	Sound Insulation	4	3	Default case of attached dwellings with separating walls/floor between non habitable rooms.
	Hea 3	Private space	1	1	Private rear garden provided.
Management	Hea 4	Lifetime homes (M)	4	4	Lifetime homes principles applied in the design.
	Man 1	Home user guide	3	3	Homeuser guide to be provided covering aspects of the dwelling and site.
	Man 2	Considerate constructors scheme	2	1	Best practise commitment to be met.
	Man 3	Construction site impacts	2	1	Procedures covering water consumption and site timber to be monitored.
Ecology	Man 4	Security	2	2	ALO will be consulted prior to planning to meet SBD conditions.
	Eco 1	Ecological value of site	1	0	Ecologist to be appointed to know the ecological value of site.
	Eco 2	Ecological Enhancement	1	1	Ecologists recommendation to be implemented.
	Eco 3	Protection of ecological features	1	0	Ecologist to be appointed to know existing ecological features.
	Eco 4	Change in Ecological value of site	4	3	Ecologists recommendation to be implemented.
	Eco 5	Building footprint	2	0	NA
Total credits / Weighting Factor			104	86 = 86.11%	

Sustainable Energy Strategy

The requirements of this development are rightly very stringent and the proposals contained herein set out to show that the overall design can and will produce a cost effective, energy efficient house. Added to this is the improved comfort level experienced by the occupants. What makes our approach so cost effective is that by using the principle of simplicity, components of the building that are necessary are optimized. Theoretical models and practical examples show that such a strategy that builds primarily upon minimizing heat losses is fundamentally more efficient than strategies relying upon passive or active solar energy use.

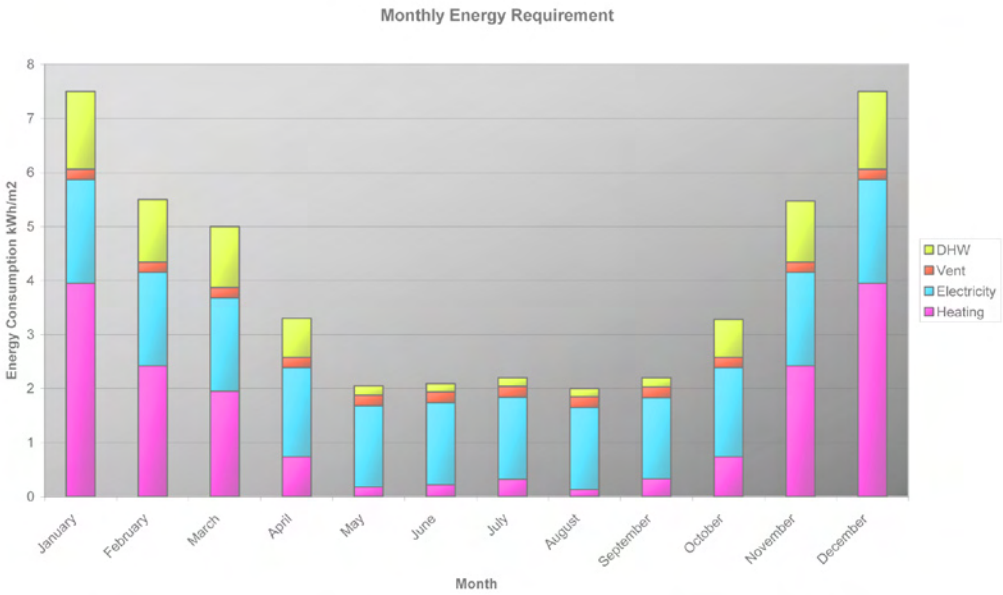


Analysis

The passivhaus standard can be met by using a variety of technologies, designs and materials. The basic elements we have included in our passive house approach are:

- Super insulation
- Efficient heat recovery and supplementary supply air heating
- 'Free' Passive solar gains
- Efficient electrical appliances and lighting
- Sensible but effective use of renewable technologies

By referring to graphs (a) and (b) we can see, the primary energy usage is calculated to be approximately 110 kWh/m²/annum well within the minimum target of 120 kWh/m²/annum. This is achieved by the prudent use of photovoltaic panels, to take advantage of free solar energy, a high efficiency condensing gas combination boiler for supplementary heating and hot water and a whole house mechanical ventilation system with heat recovery for achieving a comfortable environment and to recover otherwise wasted energy.



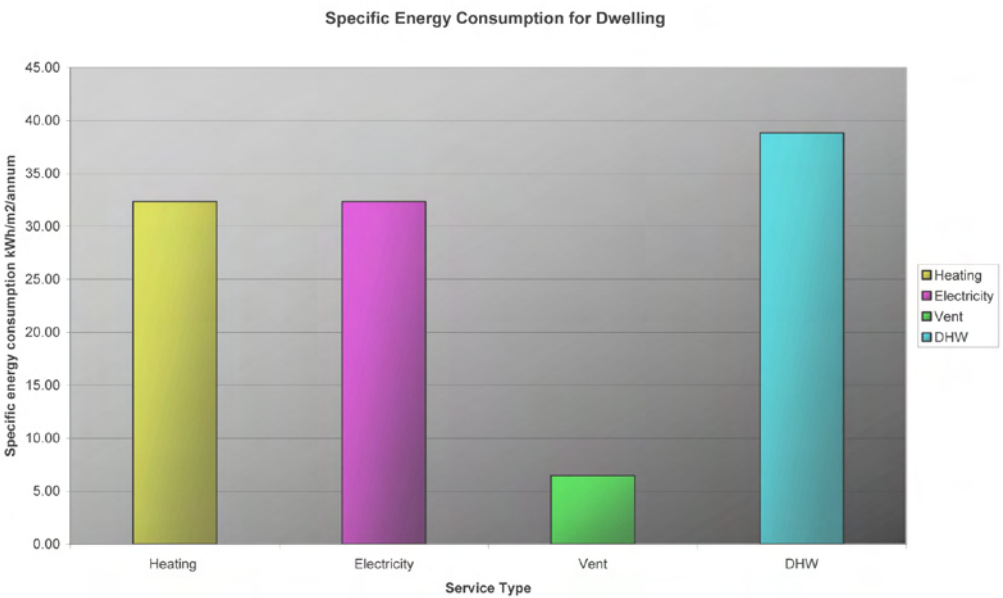
Graph (a) illustrates the projected energy usage over the year and also the calculated energy use meeting the passive house standard of 15kWh/m²/annum.

Achieving Passive House

Passive design minimizes the energy requirements of the building by making best use of natural factors:

- Passive solar strategy
- Low "U" value components in the structure
- Renewable technologies

The benefit of this approach is that there are fewer mechanical and electrical systems to maintain. The success of this approach is highly dependant on the building orientation and format. In this respect, the dwellings are to be constructed with a south facing orientation to ensure maximum gain through the photovoltaic system and fenestration. At the same time, shading systems will ensure that overheating problems are minimized.



Graph (b) indicates the possible primary energy use, on a monthly basis, from the major services installed within the dwelling. This is based on the following design parameters included in the calculations:

- The air change rate is a maximum of 0.6 per hour
- The U values (W/m²K) are:

Floor	0.15
Walls	0.16
Roof	0.11
Windows	0.7
Doors	1.4

Heating Services

The following heat generators were considered for the project:

- Micro CHP – there are now several manufacturers providing units for domestic use. A unit supplied by Baxi, the Ecogen, was considered. This provides 1kW of electricity and a minimum 3.7kW of heat. However, the unit would only generate electricity whilst producing heat. The low heat losses associated with the dwellings would preclude the unit from running for lengthy periods of time thus reducing the electrical input.
- Biomass – domestic boilers are available, but for the size required for these properties manual handling would be involved to load pellets into the hopper and disposal of the ash.
- Condensing gas combination boiler – a Worcester Greenstar boiler is considered. These boilers have high efficiencies are reliability levels. They modulate, dependant on load and can be fitted with optimizer and weather compensation. Added to this, if connected to an underfloor heating system they can be run in condensing mode thus maximizing fuel usage.

It is intended to use a condensing gas fired boiler with either underfloor heating or radiators sized for condensing mode temperatures. This heat generator would also provide the domestic hot water. Providing hot water in this way minimizes heat losses from piping and storage vessels, as water is heated instantaneously.

Whole House Ventilation System

It is proposed to install a central whole house ventilation unit with associated distribution ducts to all sections of the dwelling. The unit incorporates a high efficiency heat recovery unit that is capable of recovering up to 91% of the heat from the discharge air. The unit has a summer by pass valve incorporated to ensure that the supply air is diverted around the heat exchanger. Similarly, for winter periods the unit has a frost protection device that ensures that cold air is not introduced into the building. A valve is modulated to allow fresh air to mix with air from the internal spaces and increase the fan speed to ensure that the required air flow is maintained. The unit is fitted with a speed controller and, if required, individual room controllers can be fitted.

Electrical Systems

By fitting the passive house with efficient household appliances and low energy fluorescent lamps, energy consumption is reduced greatly when compared to the average housing stock. All building services are designed to operate with maximum efficiency. As electricity is the most expensive form of energy provided, it is proposed to install a photovoltaic array to provide approximately 3.7kWp. The approximate annual output, of this array, would be 3000kW. Although not providing an acceptable payback, the input into the electrical requirement of the dwelling would be substantial.

Cost Summary

Provided is an elemental cost breakdown to demonstrate the design can achieve the stated construction budget of £1200 / m²

ELEMENTAL ESTIMATE			
	GIFA	m2	
	Ground Floor	51	
	First Floor	57	
		108 m2	
ELEMENT	£ Total Cost of Element	GFA £/m2	GFA £/m2
SUBSTRUCTURES	10,560	97.78	
SUBSTRUCTURES TOTAL	10,560		97.78
BUILDING			
Frame inc upper floors	12,250	113.43	
Roof	6,845	63.38	
Stairs	750	0.00	
External Walls	17,270	159.91	
Windows and External Doors	7,936	73.48	
Internal Walls and Partitions	3,000	27.78	
Internal Doors	4,050	37.50	
Wall Finishes	5,600	51.85	
Floor Finishes	3,807	35.25	
Ceiling Finishes	3,240	30.00	
Fittings (PROV SUM)	1,950	18.06	
Sanitary Fittings	2,025	18.75	
Mechanical Installations	713	6.60	
Gas Combi Boiler	1,000	9.26	
Solar Hot Water	4,500	41.67	
Heat Revcovery Whole House Ventilation	4,500	41.67	
Rainwater Harvesting	4,250	39.35	
Electrical Installations	5,145	47.64	
BUILDING TOTAL	88,831		822.50
EXTERNAL WORKS (ALL PROVISIONAL SUMS)			
Drainage	2,500	23.15	
Site Works	2,500	23.15	
Composting Bins and Water Butts	500	4.63	
Shed / Bike storage	750	6.94	
External drying facility	150	1.39	
Bin Store	1,000	9.26	
EXTERNAL WORKS TOTAL	7,400		68.52
	106,791		
PRELIMINARIES @ 15%	16,019		148.32
TOTAL CONSTRUCTION COST ESTIMATE at 3rd Quarter 2009	£ 122,809	£	1,137.12