

'Model D' House

Case Study produced by the A+DS
Sust. Programme.



'Model D' House



^ External view of the house

The Model D house is a very low energy and contemporary home that demonstrates the innovative and creative use of home-grown timber which is good value and a model for affordable housing stock in the countryside.

BACKGROUND

The house is located near Inch in Aberdeenshire, and is designed to demonstrate an alternative to the expensive and often bland properties offered by volume developers. The design aims to provide an approach to rural design that relates to its context and could work on a larger scale rather than kit-built homes that are unaffordable.

APPROACH

The client's aims were to develop alternative contemporary design proposals that would facilitate the provision of affordable, good quality and low-energy designs that utilise home-grown timber.

The design also seeks to stimulate revisions in our current thinking about rural house design, including the architectural design, and increased ecological awareness concentrating on more environmental-friendly design and use of local materials.

PROCESS

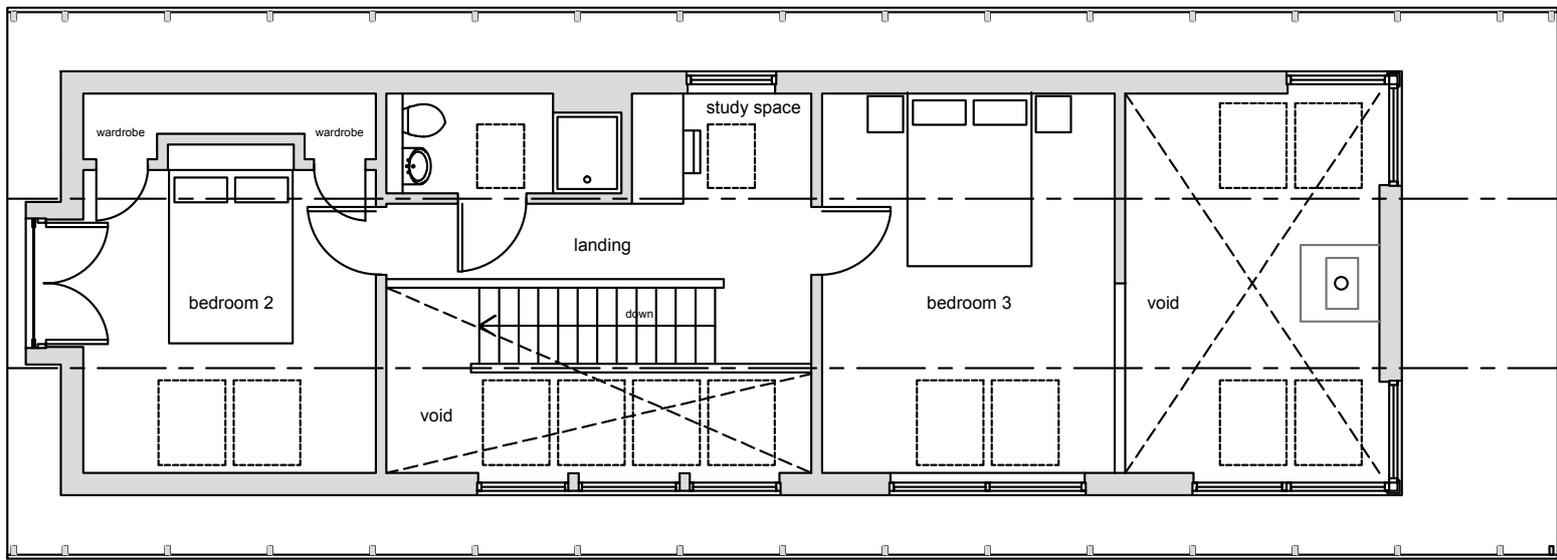
The manufacture of the superstructure uses home-grown Scottish timber which was delivered on-site in open panels, but the house was largely stick built on site due to the specification of smaller timber sections.

The decision was taken to experiment with an enhanced form of timber kit frame for the house by adopting an innovative double-stud wall and roof arrangement. This allowed the use of standardised timber kit construction sizes which were adapted to provide the necessary requirements for U-Values and air-tightness. The wall construction became two leafs of 95x45mm C16 timber frame panels, with a layer of OSB sheathing between to accommodate the air-tight membrane. Similarly, the roof arrangement was that of two leafs of structure and framing, with an air-tight membrane layer between, forming a continuous air-tight layer within the walls. The roof structure was constructed of individual rafters with a ridge beam and purlins throughout the length of the house. This was a preferred method to allow for the air-tight membrane to remain continuous and to allow the use of local C16 timbers. The floor is timber, supported on strip foundations, with insulation tightly fitted between the joists and the air-tight membrane lapped with the wall membrane and then taken over and across the joists to continue the air-tight layer enveloping the house. Internally, a service zone, 25mm, was created on both wall and roof slope to allow for the distribution of services throughout the house without having to duct them through the insulated fabric.

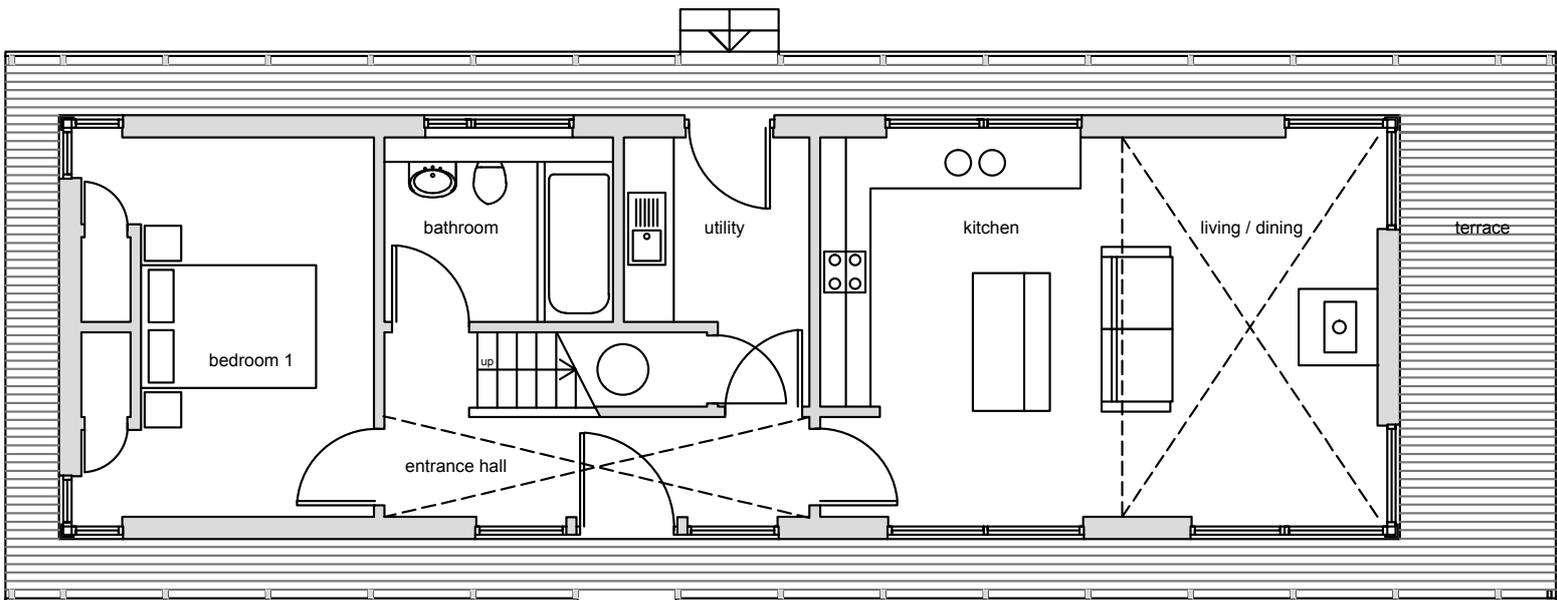
<< The Model D House at night

Ground Floor and First Floor Plans

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First floor



Ground floor





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The house was designed to the German 'PassivHaus' standard, whereby houses are designed with a high thermal performance and exceptional air-tightness to minimise heating demand. All elements that make up the building fabric – walls, roof and floor – are designed to be below a U-Value of $0.15\text{W/m}^2\text{K}$ and an air tightness of $0.6\text{ m}^3/(\text{h.m}^2)$ @ 50Pa.

The house does not have a gas supply, a common drawback to rural housing. The electrical energy is supplied from the grid and set on a low off-peak tariff to make the use of electricity for heating, lighting and cooking more competitive.

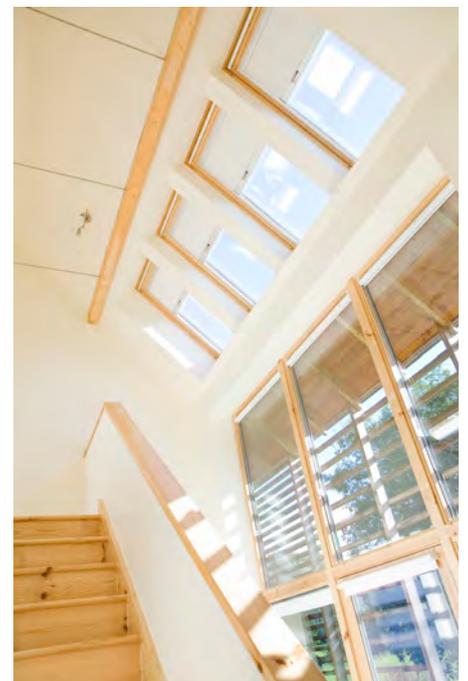
The 'Model D' house uses a 5kW wood burning stove as its primary heat source, with electric panel room heaters to provide additional heat input where there is high demand during peak periods of cold weather. Hot water is supplied through 4.64m^2 solar thermal panels with an off-peak boost through an electrical immersion heater for additional heat input.

In summary, the approach was to create a flexible living space. The house was designed with a simple long rectangular plan, providing an open plan living/dining and kitchen space and 1 double bedroom on the ground floor (to comply with 'lifetime homes'). There is a separate rear utility room with space for recycling storage and a downstairs bathroom. Two additional double bedrooms, plus an additional shower room is located within the attic story, accessed off an open gallery space. The bedroom over the main living space (bedroom 3) can either be used as a dedicated bedroom, or alternatively the wall into the void can be opened to provide a dedicated studio/home office space with occasional sleeping arrangements. The living spaces and the main circulation space have both been designed to make use of the double height space available to give the interior a sense of light and space. The design incorporates a terrace around the house that forms a buffer space, protected by the timber screen, but also a usable outdoor space for the occupants. Large south facing floor-ceiling openings take advantage of the solar gain, and maximise views whilst at the same time expressing the building's contemporary domestic credentials.

RESULT

The 'Model D' house was constructed almost entirely from home-grown timber, and designed to meet the Government's 'Zero-Carbon' targets in new housing developments in 2016. It is built with an innovative double-stud system for wall and roof construction which also accommodates a continuous use of polythene sheeting for a maximum air-tightness to meet the 'PassivHaus' standards.

The external rain screening is oven-treated home-grown Larch timber with a long life. The screening protects the inner Pine timber wall cladding, and also provides the house with its own micro-climate. The 'Model D' House offers a viable and affordable housing option for rural communities where fuel poverty is a major concern with the rising costs of energy.



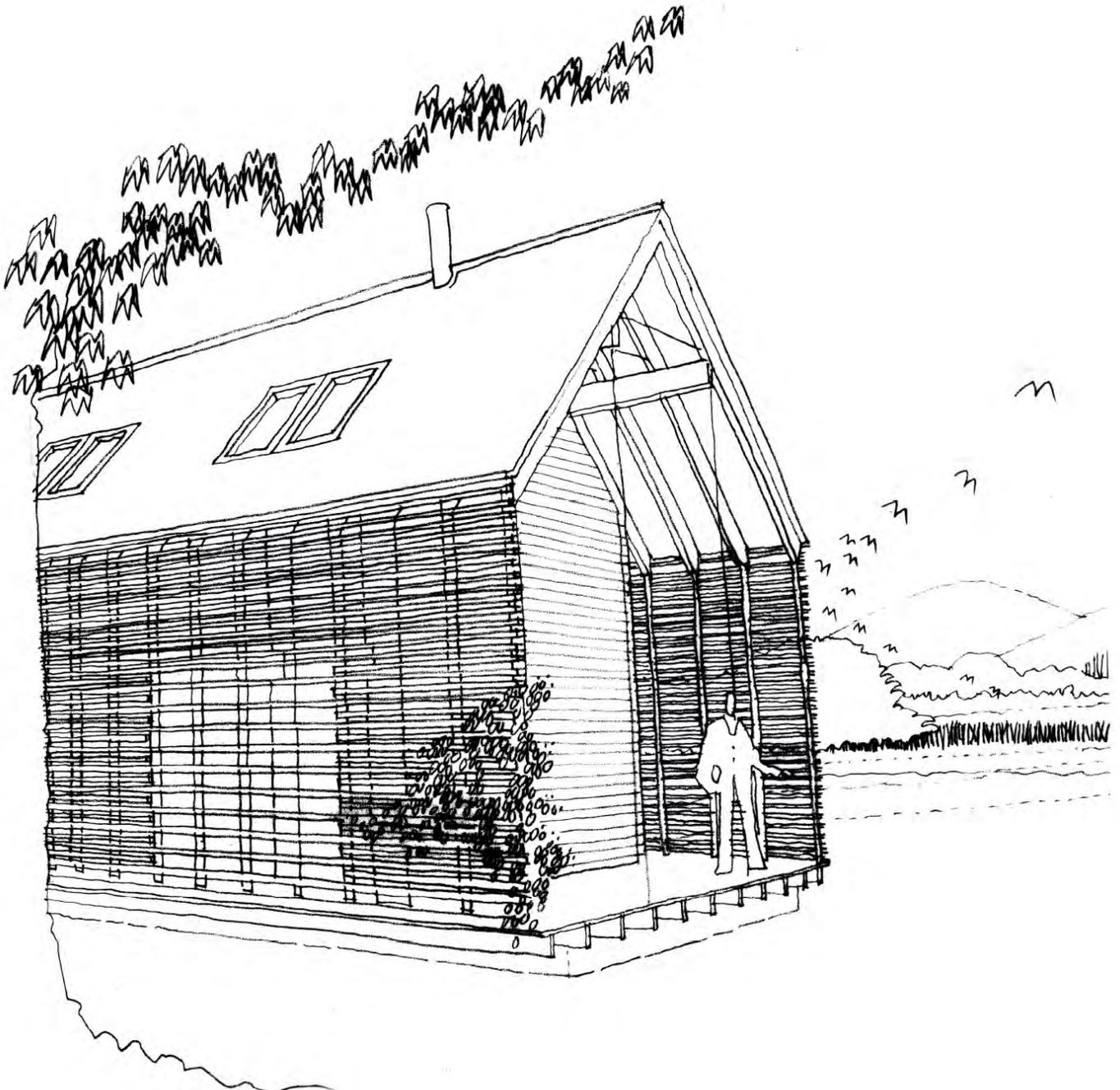
^ Internal view of the house illustrating the double height space

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The architectural language of traditional North East agricultural buildings has been adopted. The large window openings in the South facade take advantage of the solar gain and maximize views, at the same time expressing the building's contemporary domestic credentials. Durability and homogeneous appearance is provided by the meticulously detailed external rain screen which provides shading and privacy where required.

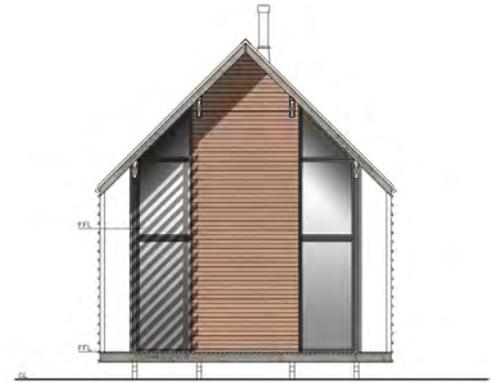
This development illustrates that sustainable and energy efficient design is possible on a low-budget and the affordability has not been achieved at the expense of architectural design or construction quality. The 'Model D' house is a very low energy contemporary home. It demonstrates the innovative and creative use of home-grown timber, costing less than £900 per square metre to build. It represents spectacularly good value, and is a hard-to-beat model for genuinely affordable housing stock in the countryside.

> Sketch of the 'Model D' House





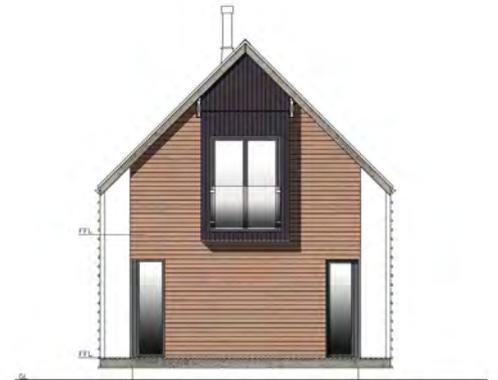
South elevation



East elevation



North elevation



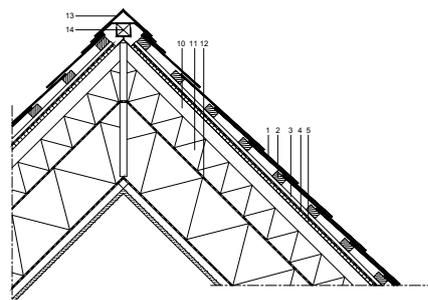
West elevation

^ Elevations

Illustrative section through the house v

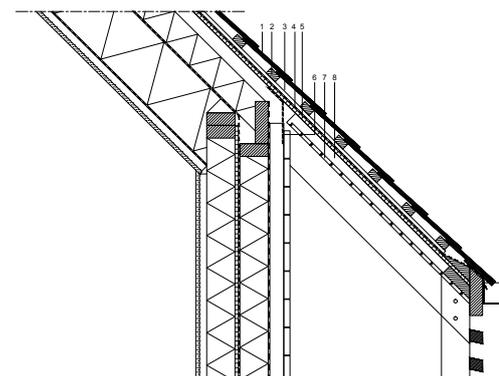


v Detailed section of the roof



Roof ridge | vertical section

- 1 Fibre cement slate
- 2 Slating battens
- 3 Counter battens
- 4 Roofing membrane
- 5 OSB3 roof sarking
- 6 Insect mesh
- 7 T&G linings
- 8 Batten
- 9 Gutter, Aluminum box profile
- 10 Ventilation gap
- 11 Thermal insulation
- 12 Polythene membrane (for airtightness)
- 13 Ridge tile
- 14 Marley Elermit RidgeFast



Roof eaves | vertical section



The 'Model D' house in its context [^](#)

External view of the house at night [v](#)



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IN USE

The overall design is simple, while the material choices and detailing are to a high standard and aesthetically pleasing. The layout and the use of open double height spaces have resulted in the increased levels of natural daylight, making for a more pleasant and spacious interior environment.

Although the intention is to undertake detailed post occupancy evaluation studies on the house, the 'Model D' house has been open to the public as a show house which allowed the design team to engage with feedback. The large majority of the public were enthusiastic about the design of the house and the feeling of generosity and space within the internal spaces. They also expressed their delight at the fact that the 'Model D' house represents the architects and clients/builders ambition for what the future of affordable housing could be like. Many initially perceived the house as not being an affordable house, whilst others changed their reactions and opinions towards affordable housing.

Additional comments from both the public and the current occupiers of the house have been that the levels of lighting, functional space, heating and cooling provide a comfortable living environment. The continued monitoring that is taking place will confirm whether the house is indeed achieving the energy performance predicted and the levels of comfort throughout the year.

✓ Internal view of the house



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KEY LESSONS

The key challenge was to deliver low energy housing for the affordable market. Low energy housing is often viewed as involving a degree of experimentation and a costly ambition to set and for any housing project, let alone for affordable housing. The 'Model D' house used standard construction techniques but in an innovative, yet discrete and sensitive manner. The key to the success of the project was the knowledge that both architect and builder had the aim of rationalising the construction processes, seeking to integrate building design and low energy strategies. Only by engaging in this relationship was it possible for the development of the 'Model D' house to become a truly affordable house.

The relationship between the architect, client and manufacturer, in this case, was critical in delivering this affordable housing project to the target specification. The two parties did not follow a traditional contractual relationship but instead recognised the strengths of each throughout the entire process – from concept design through to completion. This was aided by the extensive research that was undertaken during the design stages on various aspects of the house, its design and specification. The house represents the outcome of an innovative approach to developing and delivering low cost, low energy housing.

Undoubtedly, the most important factor in the success of the 'Model D' house was the architects' unique position of being closely involved with the client (and builder) from the outset. This long-term relationship allowed for more innovative sustainable strategies to be considered. This relationship remained upon the completion of the 'Model D' house, whereby both parties undertook a one year Knowledge Transfer Partnership (KTP) to review and develop the Model D house based on the lessons learned with the aim of refining construction processes, specifications and performance.

The house demonstrates that home-grown Scottish timber can be used to construct low energy affordable homes for Scotland. However, issues have been identified with the long term durability of the specified timbers, in particular the cladding and the decking requiring regular maintenance.

The 'Model D' house was able to demonstrate that good design is possible within the tight budgets demanded by the affordable housing market. The house has an outwardly appearance of that of a bespoke one-off house; however we do not see this as a bad characteristic, but as being better than the current standard translates to the promotion of a new ambition for what we and society views as 'affordable housing'.



Project Information

Location:	Pitmachie near Inch, Aberdeenshire
Client:	Sylvan Stuart Ltd
Date Completed:	October 2011
Project Value:	£140,000 (excl. Site works)
Gross floor area:	155m ²
Architect:	Gokay Deveci ARB RIBA FRIAS
Main Contractor:	Sylvan Stuart Ltd
Awards:	Aberdeen Society of Architects 2012 - Design Awards - Highly Commended RIAS 2012 - Award Winner RIAS Wood for Good - Award Winner 2012 Saltire Housing Design Awards - Winner Scottish Design Awards - Commendation
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