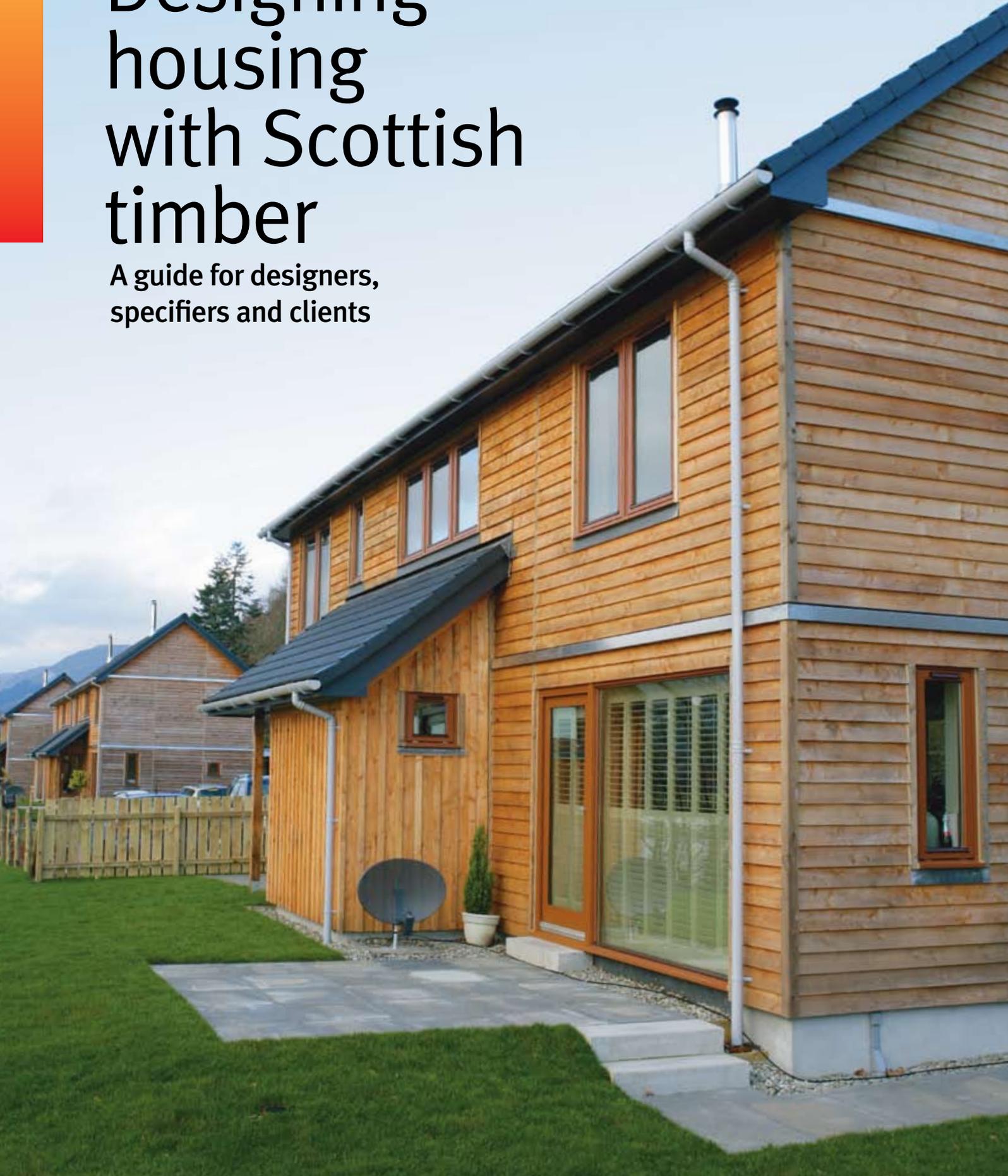
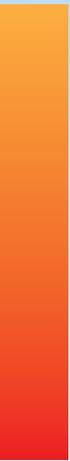
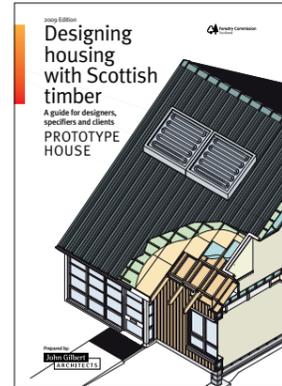


Designing housing with Scottish timber

A guide for designers, specifiers and clients



The Forestry Commission has produced a wealth of practical information from innovative projects outlining the uses and benefits of designing with Scottish timber.



Download the full report at www.forestry.gov.uk

Providing locally sourced and produced construction materials is a key part of the sustainable design agenda. Rural Scotland is on the periphery of most transport networks and has vast timber resources; the potential to reduce transportation and increase local employment is huge.

The Forestry Commission appointed John Gilbert Architects in 2004 to examine current sustainable housing and use the lessons learnt to develop a new prototype, maximising the use of Scottish timber in rural, affordable, low-energy housing provision.

The report also examines practical implementation issues such as costs and procurement.

Updated for 2009

Since these reports were issued in 2005, a number of houses have been completed as 'pilot projects' and the experience gained was used to update the report for 2009.

The reports are available on the Forestry Commission website at: www.forestry.gov.uk in two parts:

- Designing housing with Scottish timber: Case Studies
- Designing housing with Scottish timber: Prototype House

The Prototype

The rural prototype was developed for social and affordable housing provision. The key design considerations and materials are illustrated on p3-4. These houses were costed at a variety of specification levels in

line with Scottish Government social housing funding criteria and space standards.

The houses are suitable for a rural location and there is some flexibility in the orientation and site. The report shows how the design was developed and the assumptions it was based on.

Green to Greener specification

As the prototype developed, we developed a matrix of materials and technologies that show how future low-carbon targets – based on the Scottish Government's 2007 Sullivan Report – can be achieved. Green to Greener shows how these targets could be achieved and the cost associated with each target in relation to current building standards (at 2008 costs).

The Pilot Projects

Two pilot projects have been undertaken into maximising the use of Scottish timber in rural affordable housing.

They were built by Housing Associations, constructed on rural land previously owned by the Forestry Commission and received Scottish Government support and funding. Both have been built by local contractors for local people.

Both projects embraced the sustainability agenda and have a number of innovative low-energy features.

PILOT PROJECT:

Glenmore

TWO HOUSES FOR KEY WORKERS IN A SENSITIVE FOREST SITE IN THE HEART OF THE CAIRNGORMS NATIONAL PARK FOR ALBYN HOUSING SOCIETY DUE FOR COMPLETION IN MARCH 2009.

Matt Bridgestock of John Gilbert

Architects: This pilot scheme investigates the maximum use of timber sourced in Scotland in low-energy social housing and was based on the prototype in the report. The design uses local timber, very high insulation levels and minimal impact materials. The layout and style are informed by the forest context and the traditional architecture of the area. The houses are orientated to the main views through the forest with the large living room windows enhancing the connection between the two. Staircase windows allow views to the north and south through the tree canopy to the mountains beyond.

Outside, new native species of trees will



be mixed with the existing mature trees around the clearing, thus maintaining the forest setting.

The design features:

- very highly insulated walls, floor and roof, substantially above Building Regulations standards
- multi-fuel stove heating for main rooms
- oriented to ensure maximum light in main rooms
- rainwater harvesting system
- draught lobbies, low flush toilets and showers.

PILOT PROJECT:

Kilmun

TWO, THREE BEDROOMED SEMI-DETACHED HOMES AND TWO, FOUR BEDROOMED DETACHED HOMES AT KILMUN IN ARGYLL FOR FYNE INITIATIVES

Iain Campbell of CP Architects: This scheme provides energy efficient and affordable homes maximising the use of Scottish timber within a sensitive coastal location in Argyll. The layout and style of these contemporary villas aims to respect the varied linear settlement pattern and architectural style of Kilmun and surrounding area. The houses are orientated towards the road and shoreline affording a south-westerly aspect over the head of the Holy Loch.

The design of the houses integrates the use of Scottish timber to form the structural frame, cladding and provide a heat source. The design features:



- highly insulated double stud walls, floor and roof above current Building Regulations
- multi-fuel stove for open plan living and kitchen areas linked to hot water with provision for future connection to solar panels
- secondary backup electric panel heating with points only fitted in bedrooms
- orientated to ensure maximum daylight and views out to living rooms and all bedrooms.

THE CONTRACTOR'S EXPERIENCE

The contractor is Macleod Building of Granttown-on-Spey who were asked about their experience.

How did you achieve the local timber brief?

We sourced the home grown timber from a timber kit supplier – Alexanders Timber Design in Troon who manufactured all the structural components. The specification did not cause the kit supplier any difficulties

Were there any difficulties with the material?

The materials required for all other aspects of the house are being supplied by a local sustainable timber supplier – Russwood in Newtonmore – and are readily available.

How did you find suppliers?

The timber merchant is very helpful and knowledgeable.

THE CONTRACTOR'S EXPERIENCE

Kilmun was built by John Brown of Strone.

How did you achieve the local timber brief?

We purchased structural timber frame materials from a local supplier – Cowal Building Supplies in Dunoon – who issued us with a letter of confirmation that the sawmill that supplied them sources 30% of its Scottish timber from Argyll forests.

Were there any difficulties with the material?

Some of the material was of a slightly poorer quality than imported timber but not to the extent that we first thought. The material was fit for purpose.

How did you find suppliers?

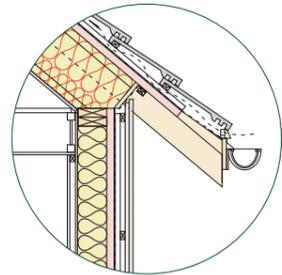
The timber merchant was very helpful and knowledgeable. The timber was less than 2% more expensive than imported timber.

A summary of the key points learnt through the research for this report, outlining the most suitable building technologies available for rural housing in Scotland.

A sustainable Scottish timber house

Roof

The roof is where the highest proportion of heat can be lost in a house. The greatest available depth for insulation can be achieved through the use of timber composite web beams (currently only available with an imported timber flange and



Scottish timber OSB web). The beams have full insulation fill and are sheathed in an insulating wood fibre board which replaces the traditional sarking. This breathable construction ensures good internal air quality and allows the creation of a 'room in the roof' section. Alternatively, the roof could be constructed of solid Scottish timber rafters, 225mm in depth, with insulation above and between the rafters of a more common synthetic material.

Sunspaces/draught lobbies

A sunspace is a glazed unheated space used to capture passive solar heat gain. It should only be situated on a roughly south-facing wall where there is very little overshadowing. If masonry walls are used for its internal sides, these will form

a natural heat store, soaking up heat during the day and releasing it at night to warm the house. Also acting as a draught lobby, this intermediate space reduces heat escape when the external door is opened.

Doors and windows

Timber doors and windows offer a lower embodied energy and lower toxicity than metal and plastic. Specification of glass coatings, gas infill and glass thickness all have an effect on the thermal

transmission of a window. A timber-framed window, triple glazed with low-emission glass and argon gas fill is currently the most thermally-efficient practical option.

Solar water heating

Solar water panels are one of the most efficient sources of renewable energy and are proven to be effective in all areas of Scotland. These are used to pre-heat water reducing the additional energy required to achieve the required water temperature.

To achieve the greatest efficiency, a mainly south-facing pitch of over 30° is required with minimal overshadowing. Incorporating suitable storage tanks and more sophisticated controls can increase the amount of energy saved.

Airtightness and breathability

Airtightness is a measurement of the degree to which air and heat is prevented from escaping through joints or openings in the construction. As buildings become more insulated, air leakage becomes a significant contributor to heat loss. Strategies to

reduce air leakage are: good detailing, close jointed external sheathing boards and careful site monitoring of construction, particularly around the openings. Controlled ventilation (such as window vents and extract fans) is still required for health purposes.

Insulation

From the large amount of insulation products available we chose natural hygroscopic materials such as wool, hemp, wood fibre and recycled

cellulose products (generally made from newspaper). These low-allergen materials do not pollute internal air and are low-carbon.

Cladding

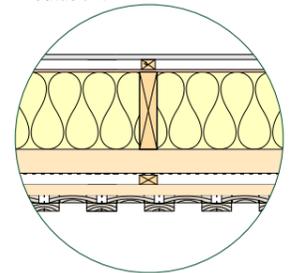
Choice will depend on the site location and availability of good quality heartwood larch. Most can be classified as class 3-4 (moderately or slightly durable), variability occurs and quality can reduce to class 5 (not durable).

UK larch should therefore be treated with a preservative when used as an external cladding, unless grading and selection can guarantee a class 3 product. Good detailing and design also remain important factors.

Wall construction

Walls can be constructed either from a solid timber kit in a range of sizes from 89mm to 195mm or, if above this depth, an I-section composite timber frame can be used. C16 graded Scottish timber is suitable for solid studs provided this is taken into account in the frame design. Wood fibreboard can

be substituted for plywood sheathing providing additional insulation.



Floor

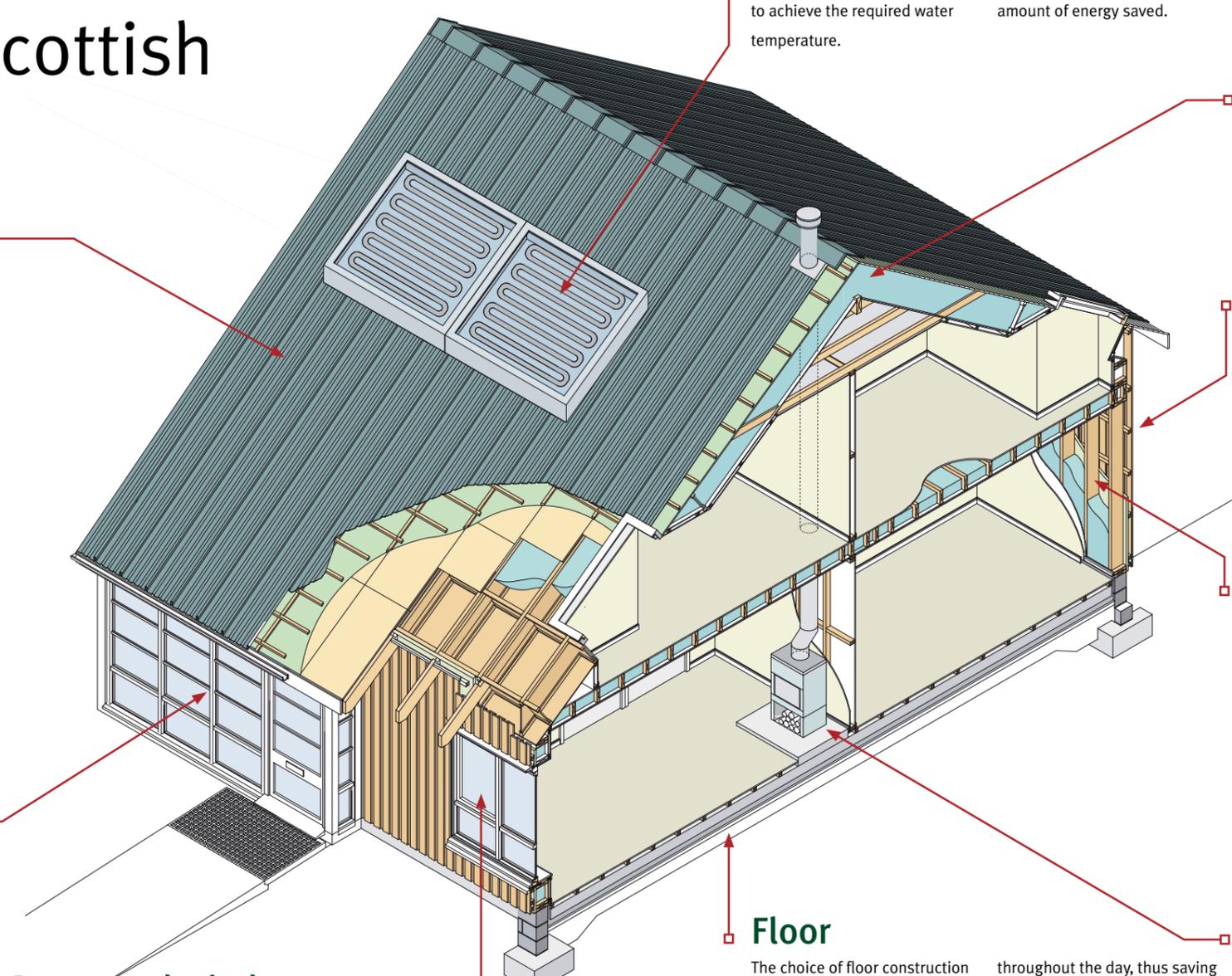
The choice of floor construction is generally a result of the most suitable foundation design. However, in a timber-framed building, the floor construction presents the best opportunity to create thermal mass which, once warm, helps maintain an even internal temperature

throughout the day, thus saving energy. In a highly insulated house where a solid floor is achievable, 200mm of expanded polystyrene, or equivalent closed-cell insulation below the concrete slab can achieve this.

Heating

We have assumed that mains gas will not be available and technologies such as woodfuel boilers and log stoves will be practical alternatives. Electric heating could be used as a back-up system or for primary water heating. The higher the insulation and

thermal efficiency, the less need for heating. We assume that heating will only be needed on the coldest days of the year because enough heat is generated by occupants and appliances, and if roof U-values below 0.1w/m2 can be achieved.



Green to Greener House Specification

Five approaches to timber house construction – from current minimum standards with high CO² emissions – to a specification leading to almost zero emissions. Calculations are based on SAP 2007 calculation method in the Scottish building regulations.

Using this data and taking an average site, with average occupancy, a total energy requirement per annum for space and water heating is calculated, along with a CO² output and indicative cost for space and water heating.

	CO ² EMISSIONS	WALLS	ROOF	FLOOR	VENTILATION	HEATING	BUILD-COST INDEX
		All with sustainable Scottish timber external cladding	All with clay roof tiles on battens		Air tightness standard @ 50Pa	Assumed to be off gas grid	
BASIC BUILDING REGULATIONS	<p>2.94 TONNES/YEAR 2007 emission target</p>	89 x 44 timber kit Sheathing ply 90mm glass-fibre service zone 25mm Crown Polyfoam Linerboard	Internal plasterboard 200mm rafters with Rockfall Underlay between 70mm Rockfall Overlay sarking board	Solid Floor - OSB flooring on Battens on Screed on 70mm Dow Floormate 200x on concrete slab	Individual mechanical extract fans Ten air changes per hour	Air-to-water heat pump with thermostat Electric radiators Electric immerser boost with off-peak load	100
ENHANCED	<p>2.10 TONNES/YEAR 2010 emission target</p>	145 x 44 timber kit Panelvent 145mm cellulose (Warmcell) OSB internal Service zone Plasterboard	Internal plasterboard 250mm rafters with cellulose (Warmcell) insulation between 33mm wood fibre Isolair board	Solid Floor - OSB flooring on Battens on Screed on 100mm extruded polystyrene 200x on concrete slab	Passive stack ventilation system Ten air changes per hour	Air-to-water heat pump with time and temperature zone control Closed wood log stove Electric immerser boost with off-peak load, green electricity tariff	104
ENHANCED (HIGH THERMAL MASS)	<p>1.72 TONNES/YEAR</p>	145 x 44 timber kit 35mm Isolair wood-fibre board 145mm sheep's wool Paneline Service zone Plasterboard	Internal plasterboard, 300mm timber composite beams with cellulose (Warmcell) insulation between 33mm wood fibre Isolair board	Solid Floor -PFA levelling Screed on Concrete slab on 100mm extruded polystyrene 200x on concrete slab	Passive stack ventilation system with solar roof ventilation Five air changes per hour	Manual feed log stove (Clearview Pioneer 500) Electric storage radiators on Eco 2000 tarriff, green supplier Electric immerser boost with off-peak load, green supplier	106
HIGH INSULATION TIMBER	<p>0.75 TONNES/YEAR 2013 emission target.</p>	194 x 44 stud 60mm Pavatherm wood-fibre board 194mm sheep's wool Paneline Service zone Plasterboard	Internal plasterboard, 300mm timber composite beams with cellulose (Warmcell) insulation between 33mm wood fibre Isolair board	Suspended Floor - OSB flooring on 250x45mm joists with 200mm sheep's wool between	Passive stack ventilation system with solar roof ventilation Five air changes per hour	Log stove with direct feed to HWC and hallway radiator with TRV (Clearview Vision 500 with boiler) Electric storage radiators on Eco 2000 tarriff, green supplier Solartwin panels linked to HWC, linked to wood stove	122
LOW EMISSIONS	<p>0.42 TONNES/YEAR (2016 target is zero carbon)</p>	300 web stud Panelvent 300mm cellulose (Warmcell) OSB internal Service zone Plasterboard	Internal plasterboard, 300mm timber composite beams with cellulose (Warmcell) insulation between 52mm wood fibre Isolair board	Solid Floor - PFA leveling Screed on Concrete slab on 100mm extruded polystyrene 200x on Concrete slab	Mechanical ventilation system with heat recovery using solar panel e.g. Sunwarm system Three air changes per hour	Pellet stove providing back up, with direct feed to HWC and Hallway radiator with TRV (3G Energi Preziosa Ceramic) 0.75 KW electric panel heaters as secondary system Sunwarm solar panels heating 200 litre tank (80mm insul) with off peak and boost	132

Q&A

Is Scottish timber strong enough for construction?

Timber is strength graded. Scottish timber for softwood carcassing is commonly graded as C16 which for most house construction purposes is adequate. Higher grade C24 timbers are often used in truss constructions but many kit suppliers use C24 for wall constructions when C16 would be fit for purpose.

Is Scottish timber of a good enough quality?

Scottish timber is visually graded to BS4978 and machine graded to BS EN519 as well as being strength graded. It is usually kiln dried and pressure treated where required. It can be planed all round making the timber easier to handle and very suitable for construction uses.

Is there a problem with the supply of Scottish timber?

It depends on what grade of timber you are specifying. Most timber stockists will keep stocks of home-grown timber and there are some timber kit manufacturers who will use Scottish timber rather than relying solely on imported timber.

What cladding is suitable?

Much of the lifespan of cladding is dependant on good detailing: providing details which allow ventilation and drying out of the timber. Homegrown Western Red cedar and European larch are moderately durable species which can be used without treatment. Other timbers such as Douglas fir and Scots pine or spruce can be used but require additional coatings.



I-beams used for roof construction at Glenmore.

Should we be using I-beams?

I-beams are now made in Scotland. They have clear advantages when used in floor and roof construction where they provide a light yet strong beam. Because of the small section of the web, heat transfer is minimised. They can also be used in wall construction to provide high insulation standards. However, it is also possible to use larger homegrown timber sections and to increase insulation values with applied wood fibre boards as at Glenmore.

Can you specify Scottish timber without breaking EU procurement regulations?

In public procurement you cannot specify Scottish timber directly as materials cannot be specified on the basis of geography. Products can be specified by name irrespective of their origin. At Glenmore, we expressed the desire and intention of the client to use Scottish timber. The NBS clause did not stipulate that timber should be Scottish, only that it was the client's intention. See the Prototype section of the report for an example clause.

Forestry Commission Scotland has several resources to assist those wishing to use more Scottish timber in construction available at www.forestry.gov.uk.

Carbon Benefits of Timber in Construction

2006. THE EDINBURGH CENTRE FOR CARBON MANAGEMENT

Compares the greenhouse gas emissions and embodied energy arising from a variety of different building materials that could be used in the construction of a two bedroom semi-detached house.

Timber Cladding in Scotland

2002. IVOR DAVIES, BRUCE WALKER, JAMES PENDLEBURY

Reviews the history, current practice and potential of external timber cladding in Scotland.

Designing with Timber

2001. ARCA THE JOURNAL OF SCOTTISH ARCHITECTURE. EDITED BY PETER WILSON

A compilation of articles and guides on history, sustainable use, selection, specification and availability of timber in Scotland.

OTHER SOURCES:

The Centre for Timber Engineering

www.cte.napier.ac.uk

This independent research unit within Edinburgh's Napier University focuses on the constructional and engineering uses of timber. Activities include research and education. Their website has a number of articles, papers and useful links.

Wood for Good

www.woodforgood.com

The Wood for Good website has case studies, guides and an online learning section with courses in the use of structural timber, OSB, engineered wood products and other topics.