

Scottish Borders Local Plan

Supplementary Planning Guidance

Use of Timber in Sustainable Construction

May 2009



This document has been produced for the Scottish Borders Woodland Partnership with assistance from:



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Revision A 21.04.10 Additions to text at 2nd para of C1.1, 11th para of C1.7 and Appendix D, 'European, Japanese and Hybrid larches (Larix spp.)

Cover image: The Steading, Morebattle. Architect: Will Grime

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Glossary of terms and acronyms used in this document

BREEAM	Building Research Establishment Environmental Assessment Method
CO₂	Carbon Dioxide
CPET	Central Point of Expertise on Timber
CSA	Canadian Standards Association
CTE	Centre for Timber Engineering
ECCM	Edinburgh Centre for Carbon Management
EU	European Union
FCS	Forestry Commission Scotland
FSC	Forest Stewardship Council
GHG	Greenhouse Gas
Hygroscopic	The ability of a material to absorb and release excess humidity
MtC	Million tonnes (of) carbon
MTCC	Malaysian Timber Certification Council
PEFC	Programme for the Endorsement of Forestry Certification
PFI	Private Finance Initiative
RDS	Rural Development Strategy
SBC	Scottish Borders Council
SBWS	Scottish Borders Woodland Strategy
SCCP	Scottish Climate Change Programme
SFI	Sustainable Forest Initiative
SFIC	Scottish Forest Industries Cluster
SPG	Supplementary Planning Guidance
TDP	Timber Development Programme (of the Forestry Commission)

Some important terms in this SPG:

Provenance: Generally meaning geographical source area of raw material – i.e. the logs

Home-grown or locally grown: Timber from trees grown in the same country as where processed and used. In this SPG the very northern counties of England will also be taken to qualify, as road miles are more important than other factors.

Locally processed: As there are no large scale timber mills in the Borders, it is necessary to allow for the necessary processing of logs a little further afield than the Borders i.e. elsewhere in Southern Scotland or Northern England.

Foreign: Sourced from any country outside the UK.

Certified (timber): Timber authenticated as from a sustainable and legal source by one of the major certification schemes acknowledged in this country by CPET.

“Both in my previous role, and this role I am heartened by the positive approach taken to the sustainable use of timber in construction. Wood is a great Scottish asset and helps to make great Scottish buildings, large and small. The example the Borders is setting... needs to spread across the whole country.”

Michael Russell, Minister for Culture, External Affairs and the Constitution,
March 2009

EXECUTIVE SUMMARY

Timber use in construction is increasing throughout Scotland and the Scottish Government is implementing a wide variety of initiatives to encourage this. Scottish Borders Council (SBC) developed its policy in relation to trees, woodlands and forests with the adoption of 'Scottish Borders Woodland Strategy' (SBWS) in 2004. This guidance further develops Council policy in relation to the use of locally grown timber. This will provide environmental, social and economic benefits to the region by making better use of local resources, encouraging innovation in building design and construction, and stimulating local businesses.

The inherently low embodied energy of timber makes it an excellent choice in reducing CO₂ and other 'greenhouse gas' (GHG) emissions and contributing therefore to the Scottish share of the carbon saving target (refer p10 and box p24, 'Carbon Cycle'). Using home-grown solid timber for structural and cladding applications will help to ensure that the CO₂ emissions of transport are minimised. Contrary to the general principle of using fewer materials wherever possible, the use of more timber can, in fact, help to redress the atmospheric CO₂ imbalance - on the basis that it has not been transported large distances using fossil fuels. For the same reasons, timber is a preferred choice in fixtures and furniture – again on the basis that they have come from sustainable local sources.

Achieving sustainable construction means changing established practises and materials and recognising that this will inevitably alter the appearance of buildings in the future, especially as timber is increasingly used as an external envelope. A variety of timber species and cladding styles have been used in Scotland and Scandinavia over the centuries and this document gives guidance on the general role of timber in sustainable design and specifically the use of timber cladding, through technical best practice advice. Appendix F includes a series of case studies illustrating a range of building types and environments where timber cladding has been used successfully.

A diverse timber-based industry integrating forestry, timber processing, fabrication and design is a recognised driver of rural economies. The potential of timber to contribute to carbon management and local energy generation has raised its profile and created significant opportunities for the Borders economy.

To maximise the sustainable use of timber in construction, it is necessary to use local sources. This should be considered at the early stages of design, as not all timber types are readily procured locally and there are legal directives on procurement that limit the way materials can be specified. Scottish Building Regulations for fire protection in relation to timber must also be considered from the outset.

In order to use timber wisely to achieve the above benefits, it is necessary to be aware of a number of issues relating to the sustainability of the design, specification and procurement of timber. This document sets out these issues, points to further sources of information and provides the criteria against which development applications can be judged.

Use of Timber in Sustainable Construction

Supplementary Planning Guidance

1.0 INTRODUCTION

1.1 Although timber is a widely used construction material, its use is being re-appraised as the environmental consequences of development and climate change become increasingly recognised. This has highlighted the potential for timber construction to contribute to a sustainable 'low carbon emission' future. Timber use is increasing in a wide variety of settings in the built environment and it is increasingly used in high quality interiors as well as external claddings. Timber is also a locally produced resource that can, potentially, make a greater contribution to the Borders economy and therefore underpin the viability of Scottish Borders woodlands and forests with all the associated economic, social and environmental benefits that these can provide.

1.2 The purpose of this guidance is to explain in more detail the factors to be taken into account when considering the use of timber in construction in Scottish Borders. It sets out the basis upon which the sustainability of timber use can be assessed, offers best practice examples of the use of timber in construction and provides an introduction to relevant sources of technical information. It will be relevant to all groups in the construction sector including:

- A) Architects, engineers, designers and specifiers
- B) Builders
- C) Self builders, client groups and all end users
- D) Planning professionals and Development Control Officers, Elected Members of Planning Committees and Local Authority officers involved in the procurement or maintenance of buildings.

Buildings made entirely from Scottish timber may require more care in procurement but do not necessarily involve innovation. Neil Sutherland was amongst the very first of a new generation to pursue this goal for ecological reasons in the early 1990s. Photo: Neil Sutherland Architects



2.0 POLICY CONTEXT

2.1 This guidance is linked to and will help deliver the following related policies:

Structure Plan

Policy N20 Design

Encourage high quality design (including appropriate use of building materials, recycling of building materials and consideration of energy efficiency)

Policy E3: Timber Processing Facilities

Encourage opportunities for timber processing including proximity of sources to minimise vehicle movements

Scottish Borders Woodland Strategy (adopted as part of the Structure Plan, November 2004)

WSC1	Expand wood processing capacity in Scottish Borders
WSC2	Encourage procurement and use of Scottish Borders timber as a sustainable alternative to materials imported into the region
WSC3	Encourage SB businesses to expand production and competitiveness of 'value added' timber products
FSN3	Build the capacity of the forestry sector by enabling new partnerships
EW3	Help to deliver Scotland's contribution to reducing carbon emissions

Local Plan

Principle 1 – Sustainability

Including:

- 1 Sustainable use of land
- 2 Preservation of air and water quality
- 3 Protection of natural resources, landscapes, habitats and species
- 5 Efficient use of energy and resources
- 6 Minimisation of waste
- 10 Support to community services and facilities
- 11 Provision of new jobs and support to the local community
- 12 Encouragement of the local community in the design, management and improvement of their environment.

Policy G1 Quality standards for new development

Local Plan Policy G1 – 'Quality Standards for New Development' provides guidance on the standards relating to the form, materials and sustainability of architectural approach that should be adopted in all developments in Scottish Borders. Further guidance is being prepared on 'Design Standards', which will complement this SPG.

2.2 Developing National policy

2.2.2 The Scottish Government has been vigorously promoting the use of Scottish and home-grown timber since the 1990s and it has been made clear that national policy welcomes change and innovation in Scottish building design.

(<http://www.scotland.gov.uk/Resource/Doc/158271/0042853.pdf>)

2.2.3 The Scottish Government's 'Timber cladding in Scotland'

(<http://www.scotland.gov.uk/Resource/Doc/46910/0024271.pdf>) and 'Designing the timber façade' (in preparation) are specifically aimed at guiding the construction sector towards maximising use of timber as a key sustainable construction material. The recent publication "Sustainable Construction Timber" (<http://www.forestry.gov.uk/forestry/inf-d-6b2jfb>) adds further detail on sourcing and specifying local timber and complements this Guidance in many areas

2.2.4 The Forestry Commission Scotland (FCS) publication 'Timber Development Programme' ([http://www.forestry.gov.uk/pdf/fcfc113.pdf/\\$FILE/fcfc113.pdf](http://www.forestry.gov.uk/pdf/fcfc113.pdf/$FILE/fcfc113.pdf)) provides a set of guiding objectives to 2010 placing the sustainable use of Scottish timber in the wider context of Scotland's economy.

2.2.5 The Scottish Forestry Strategy (SFS) expresses the goal of taking the forest cover of Scotland from 17 to 25% of the land mass by 2050. That equates to a new forest area of about 6222 km² or an area the size of all the Lothian and Borders area taken together. (Even if that is achieved, the area of forest would still be less than the average EU forested area of 36% and substantially less than our nearest neighbours in Scandinavia with 37% in Norway and 70% in Sweden.)

2.2.6 The Scottish Climate Change Programme (SCCP) is currently under review but sets a target saving of 1.7 MtC across all sectors by 2010. Of this, the proposed contribution from the forestry sector is targeted at 0.6 MtC or 35% of the Scottish total. To deliver this target, the construction industry will be required to substantially increase its demand for timber but a figure has not been estimated for this.

2.3 The global and European Union context

As a signatory to the Kyoto agreement, the UK Government is legally committed to a reduction (on 1990 levels) in greenhouse gas (GHG) emissions of 12.5% by 2008-12.

(<http://unfccc.int/resource/docs/convkp/kpeng.pdf>) The Scottish Share, as set out in the Scottish Climate Change Programme, is 8.3% of the 20.7 MtC savings required. (<http://www.scotland.gov.uk/Publications/2006/03/30091039/0>)



Drawing on the traditions of Scottish slate and stone building but combining modern design concepts and detailing (Page\Park).
Photo: Renzo Mazzolini

3.0 ISSUES TO BE CONSIDERED

3.1 Timber as a Resource – see Appendix A

Timber is a natural and renewable building material that is light, strong, durable and easily workable. It can help provide healthy, pollution free built environments and at the end of its construction life has the potential to be re-used, recycled or used as fuel. For a variety of historical reasons, the forest resources of Scottish Borders have been depleted over time and the timber resource, and the skills to use it, have declined also. Now, however, the local timber resource is increasing again and there are significant opportunities to make better use of this material.

3.2 Timber and Climate Change – see Appendix A

3.2.1 Growing trees remove CO₂ from the atmosphere and store it in the carbon-rich cellulose of their woody parts. When a tree is harvested and converted into timber, the carbon remains fixed until the wood eventually decomposes or is burnt. So long as new trees are planted to replace those cut for timber, the net long term effect on atmospheric CO₂ is effectively neutral i.e. carbon neutral.

3.2.2 Fossil fuels are used to fell, transport and process timber, which results in CO₂ emissions. However, the amount released is still less compared to alternative construction materials such as steel or concrete based products or bricks which require very large amounts of energy for their manufacture, transport and disposal. The total energy consumed from extraction of the raw material to disposal of a product is known as its 'embodied energy' (refer p.18 - A.2.1). Timber, particularly from local sources, has one of the lowest 'embodied energies' of all construction materials and is therefore an efficient material to use to help minimise CO₂ emissions. In terms of response to climate change therefore, locally sourced timber is one of the most suitable materials for a variety of applications in construction.

3.3 Procurement and use of Timber – see Appendix B

3.3.1 Where timber is procured directly from a merchant, the place of origin (provenance) is not always clear, nor whether the source forest was under sustainable management. Failure to assess these issues can mean that timber from distant origins may be used unwittingly, where embodied energy is significantly higher because of transport miles. It is also possible that the source forest was being poorly managed in regard to its environment and its own long term viability.

3.3.2 All UK forests are managed under the terms of the UK Forestry Standard and so UK grown timber should always be environmentally acceptable. If imported timber has to be used, internationally recognised certification systems should be used to identify the provenance. Sources closer to the UK (e.g. Europe) will normally have lower embodied energies than sources further afield (e.g. Canada and Siberia).

3.3.3 It follows therefore that attention to the source of supply and, where applicable, to timber certification, will be required in order to demonstrate the sustainability of the timber being used.

3.4 Operational Energy – see Appendix B

Over the course of the lifetime of a building, its energy consumption in operation will outweigh the embodied energy in the materials of its construction. If its energy systems run on fossil fuels, its contribution to GHG emissions will be considerable. As part of a low carbon building strategy the use of wood-based fuels coupled with high levels of insulation, good design and building practice can significantly reduce these emissions. Use of timber framing and internal timber finishes and floors are often part of a thermally efficient design strategy.

3.5 Designing with Timber – see Appendix C

Timber can be used in a great variety of building applications; both internal and external. The success and durability of all these applications depends, however, upon the appropriate detailed design and specification of each element.

3.5.1 Of particular interest in the planning context is the use of timber as an external finish, particularly cladding. Appendix D details the species of timber commonly used for cladding; Appendix E shows the common cladding profiles that may be used. Applications for timber cladding can vary from the rustic and rural to the urban and modern, and the design and treatment of the material varies accordingly.

3.5.2 The use of timber cladding has a long history in Scotland but a relative paucity in local supplies of suitable quality combined with cheap manufactured masonry products has led in modern times to the dominance of harled or rendered masonry exteriors along with a wide variety of metal cladding systems.

The renewed interest in external timber cladding is in part a response to recent demands for a more sustainable approach to construction but it is also now seen as offering building designers renewed aesthetic opportunities.

It is important to note that timber is used in many ways in a traditionally constructed building, for example in roofs, floors, windows and doors. This may create demand for good quality timber to repair such elements of a traditionally constructed building.

Timber can be left untreated to weather naturally or treated and finished in a variety of colours to achieve markedly different effects. In vibrant or muted colours, it can be combined with masonry and other materials in endless permutations. In some exceptional circumstances (e.g. where the defined character of a Conservation Area might be impaired) timber cladding may not be appropriate.



It is likely that different models of high density and lower cost housing will need to be explored. We may have something to learn from highly energy efficient central European examples such as this from Dornbirn in Austria. Architect: Johannes Kaufmann Architektur

Policy

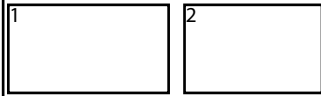
Scottish Borders Council supports the sustainable use of timber resources for a wide range of construction works in both urban and rural settings. The Council strongly encourages clients, designers, builders and managers to be aware of the potential for locally sourced timber to contribute to sustainable development and to use these materials wherever suitable opportunities arise.

The Council will give positive consideration to proposals for the use of timber within sustainable construction. The following considerations will be taken into account:

- | | |
|--|--------------------------------|
| a Support for timber throughout the building given its minimal processing requirements (embodied energy) for construction in comparison to other materials. | Guidance Note
App A.1 - A.3 |
| b Minimisation of transport by using local sources wherever possible. | App A.2 |
| c The use of timber certification, where appropriate, to demonstrate the sustainability of the source. | App B.3 |
| d The energy efficiency of the proposed construction e.g. through insulation values, aspect and orientation. | App A.2 |
| e The practicality of the design in terms of materials, species selection, detailing and treatment to maximise the durability of the specified materials. | App B.1, B.2 |
| f Compliance with Building Standards for Timber | |
| g Contribution of the proposed construction to the appearance of the built environment. | App B.4, C.2
App D, E, F |

Applicants shall provide a statement explaining how the above issues have been taken into account as part of a detailed planning application.





1. Lotte Glob House, Sutherland (2004)

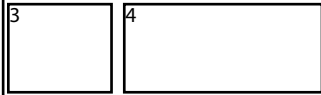
Architect: Gokay Devici

Photographer: Andrew Lee

5. Grunberg House, Sutherland (1998)

Architect: Gaia Architects

Photographer: Bernard Planterose



2. SNH HQ, Inverness (2006)

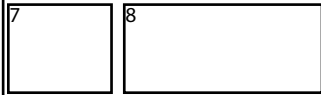
Architect: Keppie Design

Photographer: Michael Wolchover

6. Stockl House, Lochbroom (2000)

Designer: North Woods Construction Ltd

Photographer: Bernard Planterose



3. Scottish Seabird Centre, North Berwick (2001)

Architect: Simpson & Brown

Photographer: Keith Hunter

7. Visitor Centre, Mount Stuart, Isle of Bute

Architect: Munkenbeck & Marshall

Photographer: Keith Hunter

4. Private House

Architect: Neil Sutherland Architects

Photographer: Neil Sutherland

8. Robin House, Balloch (2006)

Architect: Gareth Hoskins Architects

Photographer: Andrew Lee

Appendix A

Why build in Timber?

Exemplary timber design (Reiach & Hall) enhancing landscape and utilizing local timber and skills in the Borders. Winner of SBC Design Award. Photo: Reiach & Hall



Appendix A - Why build in Timber?

Summary

The global issue of climate change has created an impetus to increase the use of timber in construction and manufacturing. An important aim for building designers is now to produce buildings with a small 'carbon footprint'. This involves a three part strategy where the building:

- (a) uses building materials which have low embodied energy and CO₂ emissions**
- (b) reduces carbon dioxide emissions in operation (of its energy systems)**
- (c) fixes significant amounts of carbon in its structure, fittings and furniture. Timber buildings perform excellently in all these three areas and present a very small carbon footprint compared with many other building types.**

A diverse, timber-based industry integrating forestry, timber processing, fabrication and design, is widely recognised as a driver of rural economies throughout the world. The potential of timber to contribute to carbon management in both construction and local energy generation has further raised its profile. This guidance identifies the issues that must be considered to develop this potential.

A.1 Timber, Sustainability and Climate Change

A.1.1 Timber as a Renewable Resource

There have always been good reasons to build in timber, and these will remain even in a hypothetical world with zero GHG emissions. They place timber use in the context of the overall goals of sustainable development as follows:

- Untreated timber is a natural and renewable building material which can help to provide healthy indoor environments. It is easy and safe to dispose of at the end of its life when it can be re-used, recycled or used as fuel.
- Timber can often be locally sourced providing local employment in the forestry and sawmilling sectors.
- Demand for timber locally encourages woodland management and woodland regeneration, which can help improve quality of landscape, biodiversity and local tourism.
- In an increasingly de-skilled world, carpentry and joinery skills and businesses are kept alive by timber construction and an architectural approach to timber design.

A.1.2 Timber and the Local Economy

The full potential of forests to invigorate rural economies is achieved where the 'added value' of downstream processing is obtained locally. There is already a busy construction sector in Scottish Borders and a new focus on materials that can be locally sourced will stimulate the timber supply chain, creating new markets for local products. This is a national target supported by the Scottish Forest Strategy (SFS) and Timber Development Programme (TDP).

Work carried out by the Scottish Forest Industries Cluster (SFIC) and the Centre for Timber Engineering (CTE) focusing on product and market development (including technological innovation) has greatly improved the understanding and profile of home-grown timber.

A.1.3 Timber and the Scottish Forestry Strategy

The ambitions of the Scottish Forestry Strategy (SFS) are far-reaching and include planting targets (to create new areas of forest and woodland) that involve at least a three fold increase on current rates of planting. To achieve these targets (in turn, part of achieving SCCP carbon sequestration targets), the demand for that timber needs to be simultaneously developed. The construction industry is seen (along with the biomass energy industry) as having most potential to fulfil that market demand.

A.2 Embodied Energy of Timber

Summary

The inherently low embodied energy of timber means its use can help in reducing CO₂ and other GHG emissions and contributing therefore to the Scottish share of the carbon saving target. Using home-grown solid timber will help to ensure that the CO₂ emissions of transport are minimised. Reliable data on embodied energy is difficult to produce but, generally, the closer the source of a material to its final destination the lower the embodied energy. On this basis, UK sourced timber will nearly always have much lower embodied energy than imported, and European sources will be lower than further afield.

A.2.1 Embodied energy and CO₂

The embodied energy of a construction material is the total primary energy consumed during its lifetime from extraction of the raw materials to the end of the product's life. This can be estimated for a single material or a whole building and the approach is often called Cradle to Grave or Lifetime Cost Analysis. Cradle to Site analysis is more common (and a lot easier to calculate) for construction materials which includes all energy consumed until the product has reached the point of use.

Timber has one of the lowest of all embodied energies (and therefore embodied CO₂) of construction materials as it takes relatively little processing to be used in a building. Used near where it is grown this remains the case but, as soon as it starts to be transported any significant distance, as with any other material, that advantage will begin to be eroded. For a given species of timber along with given growing and harvesting regime, it is reasonable to suggest that locally grown and milled timber (i.e. local to the construction site) will have a lower embodied energy than foreign timber. However, the picture is seldom as simple as this and many other factors influence the carbon footprint of timber.

This house near Ullapool (designed by North Woods Construction Ltd) is built entirely from timber sourced in the Highlands. Not only that, it was milled, processed and manufactured by one company (NorBuild Ltd) within 80 miles of the site keeping embodied energy very low. Photo: Bernard Planterose



Although sawn timber from European and Scandinavian sources generally has a low embodied energy, it should be noted that some timber products travel so far in their manufacture and final delivery that they may be said to perform relatively poorly by the criterion of embodied energy. A common example is a laminated floorboard made with a top layer of hardwood from the east coast of North America, a layer of softwood from the west coast in the middle and a layer of Indonesian timber as its base finally transported to market in the UK.

Reliable data on embodied energy and carbon is particularly hard to produce for timber on account of its hugely varying travel distances, the frequently unknown provenance of logs from abroad and varying efficiencies of harvesting and milling operations. The emerging British Standard PAS 2050 will help to bring consistency to calculation procedures but the raw data will still be hard to procure for many timber sources.

Embodied Energy Case Study

A typical 3 bedroom, detached Scottish house has been estimated to comprise 16.8 t CO₂ in construction materials (Edinburgh Centre for Carbon Management - ECCM). The target emissions for domestic dwellings are 4kg CO₂/m²/yr. If a house is 125m² then total emissions would be about 0.5 t CO₂/yr. This means that in the 'low carbon' house of the future, it would take 33.6 yrs of operational emissions to equal the embodied energy of the construction materials as currently manufactured.

However, figures produced by ECCM suggest that by using timber exterior cladding instead of blockwork and by using timber in other areas of a house where materials such as PVC are presently often used, the embodied energy of this typical three bedroom house could be reduced to as little as 2.4 tCO₂. Such figures are necessarily approximate and it is important to note that they utilise the methodology that accounts for the carbon dioxide sequestered by trees during their growth up to the point of harvesting.

A.2.2 Embodied energy and operational energy

It has often been argued that the embodied energy and CO₂ of construction materials is insignificant compared with the CO₂ emissions generated by the energy systems when heating and lighting buildings. This argument has tended to prioritise efforts on insulation and other methods of reducing operational energy. Given that the vast majority of buildings already exist (and that their construction materials are, therefore, academic in this context) this has been a logical basis for progress in energy conservation measures.

However, as we move closer to building well-insulated buildings (and there is a long way yet to go in Scotland), the embodied energy and CO₂ of the materials becomes increasingly significant. When a dwelling reaches the government's target performance of 4kg/m²/yr CO₂ emitted in use (by 2013), the construction materials of a standard Scottish house (even though timber-framed) will represent over 30 years worth of running energy! Seen in this new context, the construction materials assume a greatly increased significance (see box above for assumptions).



This cabin (North Woods Construction Ltd) was built from the spruce trees felled and milled on the site. No timber was moved more than a few yards in the whole operation minimizing embodied energy. Although the example may seem extreme, it is an approach that the Forestry Commission itself is investigating in relation to the future use of some of its own woodlands for forest housing projects. It is also implicit in the concept of forest crofts also under development with the support of the Scottish Government.

Photo: Bernard Planterose

New British Standard

The calculation of embodied energy and carbon has become such a critical measurement in the drive to reduce atmospheric CO₂ and other GHG levels that BSI British Standards are on the point of inaugurating a new standard PAS 2050 which will enable a consistent approach to this currently contentious area of evaluation. It is hoped that this will be a first step towards an internationally agreed standard.

Timber, Embodied Energy & GHG Emissions

On account of widely varying efficiencies in forest management, timber processing operations and transport types, there is no simple way of quantifying the embodied energy of different timber types by the time they are used in a construction at present. This is reflected in the widely varying values for solid sawn timber given in the ICE table: from 0.3 to 21.3MJ/kg. Sawn timber from very large milling operations utilising logs from highly efficiently managed and large scale resources (such as Swedish and Finnish forests) and then shipped in large quantities to the UK, exhibit low values. However, it should be noted that a study by the Edinburgh Centre for Carbon Management gave the following values per tonne of timber for the transportation element from different sources:

- A lorry journey within Scotland (of about 100 miles) = 0.007 t CO₂
- Sweden to Scotland by ship and lorry = 0.038 t CO₂ (5.4 times journey within Scotland)
- Latvia to Scotland by train, ship and lorry = 0.128 t CO₂ (18 times journey within Scotland)
- Canada to Scotland by ship and lorry = 0.134 t CO₂ (19 times journey within Scotland)
(A reduction in emissions could be generated for the journey within Scotland by using train instead of road transport.)

Source: ECCM – Forestry Commission Scotland Green House Gas Emissions Comparison – Carbon benefits of timber in construction (2006)

UK Database of Embodied Energy

The most comprehensive and up to date embodied energy database of building materials (around 170) is known as the Inventory of Carbon and Energy (ICE) and is available for download as a PDF file from the Dept of Mechanical Engineering (University of Bath) (<http://people.bath.ac.uk/cj219/>). As the database spells out, timber is particularly difficult to place meaningful values on as the distance of transport to site makes a huge difference to a material with such an inherently low embodied energy. The database also chooses to discount sequestered carbon altogether which some other databases have included. Thus values for timber in the ICE database are all positive whereas negative values generally result for sawn timber where the carbon sequestered by the growing trees is accounted for.

A.2.3 Health

Untreated timber, particularly the end-grain of timber, has the ability to absorb excess moisture from humid internal environments and release it again once the internal air dries out. Referred to as hygroscopicity, this characteristic can help to regulate relative humidity levels in buildings, which in turn can help to provide indoor environments conducive to human health.

The use of such materials can also reduce the requirement for mechanical ventilation, further improving the energy efficiency of buildings.

A.3 Fixing carbon in timber products and buildings

Summary

As trees grow they remove carbon dioxide from the atmosphere. Therefore, contrary to the general principle of using less material wherever possible, the use of more timber can, in fact, help to redress the atmospheric CO₂ imbalance. As well as in structural and cladding applications, timber is a preferred choice for the same reasons in fixtures and furniture. To obtain this benefit in full, it is also necessary to ensure that the timber has not been transported long distances or obtained from unsustainable sources.

A.3.1 Carbon literacy

Growing trees (and all other vegetation) remove large quantities of CO₂ from the atmosphere and store it in the living, carbon-rich, cellulose of their woody parts (see box p24, 'The Carbon Cycle'). When a tree is harvested and converted into durable timber products or constructions, that carbon is 'fixed' for a long term so as to be effectively removed from the global system (for as long as it takes to decompose or be burnt to release the stored carbon). This fixing of carbon dioxide in timber products is now one part of global carbon management strategies and adds to the argument for the maximisation of timber use in construction.

As a general rule it is clear that reducing the amount of material in a design is likely to reduce the amount of embodied energy (as well as cost) and engineering/ design normally strives to do this. The need to remove CO₂ from the atmosphere however suggests a somewhat paradoxical advantage in maximising timber use, especially in building structures which should be designed for very long service lives.

Whilst it cannot be claimed that carbon sequestration has been a driver in the development of the timber framing industry, it is nevertheless an added advantage to its use. The ease with which timber frames can be well-insulated is also relevant and the depth of frames has tended to increase with depths of insulation required, thus yielding a double benefit.



Solid timber furniture can add significantly to the carbon fixed within a building, especially in restaurants and educational facilities where a lot of tables and chairs are required. These examples from Woodschool use Scottish grown hardwoods in large sections. Photo: Woodschool

The argument for fixing carbon in timber buildings extends, of course, far beyond the structural frame to all components and even to the fixtures and furniture. Furthermore, the insulation itself can be made of wood fibre and such products are gaining ground throughout Europe as they can use low grade and 'waste' wood. (Appendix C itemises timber product categories in a building and provides information on the types that may be used.)

Carbon Literacy – from school to building site

A high degree of what is becoming known as “carbon literacy” is required to make well-informed decisions concerning climate change in construction. One could say that a basic knowledge of the carbon cycle as taught in the Scottish Standard Grade biology curriculum has become basic to a builder and building designer’s professional understanding (see box p24, ‘The Carbon Cycle’).

Currently, the Government is setting targets for “carbon neutral” or “zero energy” buildings. Designers who maximise timber use both in structure and fuel systems can start talking about “carbon negative” design – buildings that have a net negative carbon balance by taking out more CO₂ from the global system than they contribute. While this affords the designer a head start, it is important to remember that the building will likely consume electricity, and therefore generate carbon emissions, as soon as it is complete.

Where building designers can incorporate landscape and growing systems into their designs – particularly using trees – then further carbon gains can be made. This is currently a much underplayed strategy.

In the interests of understanding and then maximising the benefit of timber in construction, FCS give ‘Priority A’ in the Timber Development Programme to further research into “assessment of carbon impact of timber in a range of building types”.

Part 4 of this SPG also looks at some different types of structure and ways to use more timber.

A.3.2 Use of ‘Massive Timber’

Two construction systems that utilise very large quantities of timber and therefore score very highly in terms of carbon fixation are worthy of mention. One is the ancient system of log construction, particularly renowned from Viking times to the present day in Scandinavia. The other is comparatively modern so-called “massive timber” system, now gaining considerable ground in Scandinavia and Europe. Their development has been concerned with a wide variety of objectives including speed and efficiency of construction, spanning capabilities and use of relatively low grade, locally sourced softwood in engineered panel constructions (see box below).

Massive Timber

So called “Massive timber” or “solid timber” panels are manufactured throughout Scandinavia and Europe from softwood laminated by a variety of methods. Some are dry

laminated using hardwood dowels which represents the most environmentally sound and healthy method: referred to as "Brettstapel". The other main type is cross glue laminated. Either method allows for precision made, wall sized panels to be created in a factory environment reducing waste and improving quality of construction. Panels are craned together on site, dramatically cutting site times and increasing cost certainty. The timber panels are used in Europe to create the structure and the internal finished surface simultaneously, reducing dependence on other materials and simplifying construction. Wood fibre insulation is most commonly added to the outside of the panels and, when combined with timber cladding, such massive timber buildings represent arguably the most environmentally advanced building solution available today, fixing the most carbon and providing carbon neutral solutions (where the carbon fixed by the trees is accounted for in the calculation).



Brettstapel is a form of unglued massive timber and the first example of its use in Scotland is the new school at Acharacle in the west Highlands. The high tolerances of the system help to achieve 'Passivhaus' standard. Image: Gaia Architects

Scottish-grown timber in products

Establishing the true origin of timber and timber products can be a difficult task but is increasingly helped by certification schemes (see Appendix B).

Albanach was established in 2003 and is a brand which embraces best practice in the growing, processing, designing, making and retailing of home grown timber products in Scotland. All timber stock used in Albanach products can be traced from the woodland to the workshop and comes from woodlands that adopt sustainable management practices.

The Carbon Cycle– a greatly simplified version

The carbon cycle is the cycle by which carbon is exchanged between the biosphere, geosphere, hydrosphere and atmosphere of the Earth. It is immensely complex but a grasp of at least a small part of the cycle as it relates to plant and animal (including Human) life and the burning of fossil fuels is useful.

For the purposes of this SPG the most relevant points are:

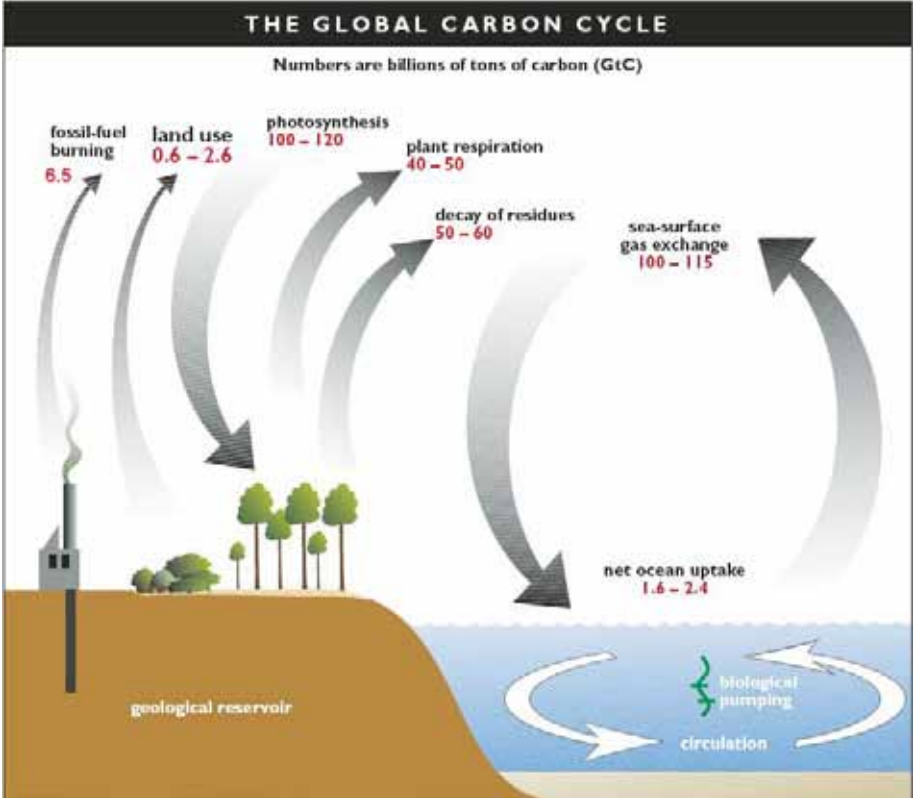
- Trees make the biggest potential terrestrial contribution to the uptake of CO₂ from the atmosphere. Removals of carbon by Scottish forests accounts for 62% of all UK removals (source: SCCP)
- Removals of CO₂ – i.e. emissions removed from the atmosphere by Scottish forests and soils – increased by 20% between 1990 and 2003 (from 2.3 to 2.7 MtC removed) – mostly by new afforestation (source: SCCP)

- A carbon savings contribution to the Scottish Target for the whole of the forestry sector has been set for the purposes of the SCCP and to focus action within the sector. The contribution is to deliver annual savings of 0.6 MtC by 2010, 0.8 MtC by 2015 and 1 MtC by 2020, through a range of policy measures. The main areas which will contribute to delivering this contribution are: 1. afforestation; 2. biomass as a renewable energy source; 3. wood as a substitute for energy intensive building materials, and; 4. timber miles (source : SCCP)
- Growing trees take up CO₂ at a faster rate than mature trees proportionally to their size
- Trees and other vegetation represent the most readily managed mechanism for CO₂ uptake available to us
- Cement production is the third largest cause of man-made CO₂ emissions. While fossil fuel combustion and deforestation produce a significantly larger amount of CO₂, cement production accounts for 2.5% of total worldwide emissions from industrial sources (source: Information Unit on Climate Change).

Best Practice European example

One of the most developed and celebrated examples of highly integrated and strategic resource planning is seen in the Vorarlberg province of Austria. Over twenty years of close collaboration between architects and timber manufacturers, later winning the support of the Local Authorities, has positioned the province as a world leader in timber construction coupled to low energy and zero carbon building technology. The Vorarlberg experience is hailed in Europe and beyond as an exemplar of ‘innovation politics’ where private industry, local government and development agencies work together to achieve goals that require a very forward looking vision. The sustainable development of construction technology, timber fabrication, local energy provision and forestry are all integrated in a manner to which we may aspire in Scotland. Furthermore, the resulting diversely wooded yet inhabited and mountainous landscape is one of the most attractive in Europe.

Right:
 The Global Carbon Cycle
 Source: <http://www.esd.ornl.gov/iab/iab2-2.htm>.
 A more detailed version of the carbon cycle is available at <http://genomics.energy.gov/gallery/carboncycling/detail.np/detail-01.html>



Appendix B

Procuring solid timber and timber composites

A sawmill and timber processor specializing in the supply of home grown timbers to the construction industry in Scotland is Russwood of Newtonmore. Photo: Russwood



Appendix B - Procuring solid timber and timber composites

Summary

This section deals with procuring timber direct from sawmillers, both large and small, in Scotland as distinct from purchasing timber through merchants. 84% of timber used in the UK is imported and mostly sold through merchants who are not well set up, for the most part, to differentiate between different geographical sources. However, the quantity of certified timber (refer section B.3) coming through this route is steadily increasing and, those concerned about the source of timber and its environmental and social footprint, should specify it. The more who ask, the more pressure is exerted on suppliers to source such material.

It is necessary to investigate local procurement possibilities at the early stages of design. Not all timber types are readily procured locally and some research will be necessary. There are specialist timber suppliers in some parts of Scotland able to meet most orders for home-grown timber to a wide range of specifications. Attention to good practice design and detailing will aim to minimise treatment of timber with its associated downstream maintenance and waste disposal issues.

B.1 Basic principles

The availability of different species and different timber processing facilities locally may have a profound effect on the design itself and its viability. Some knowledge of the processing that timber goes through is necessary. It is also necessary to establish what species are available locally and what parts of a building the local timber is being considered for.

For anyone considering the specification of locally sourced timber, this early knowledge may also be invaluable as part of the brief to an architect or designer, that may subsequently be employed. (N.B. It should not be assumed that they will have detailed knowledge of local timber processing facilities, and therefore of available products!)



A sawmill and timber processor specializing in the supply of home grown timbers to the construction industry in the Borders is Abbey Timber. Photo: Willie Dobie

B.2 Key specifications for solid timber

B.2.1 Strength grading

All timber used in structural applications must be strength graded to meet the grade specified by a structural engineer in the building design documentation. Such grading is carried out to verify the strength of timber, and may be done mechanically, visually or acoustically (for some species). Whilst large mills have machines, small mills sometimes use trained visual graders who carry certification. This includes a number of mobile sawmill operators. The majority of small sawmills in Scotland do not have any form of strength grading facilities. This will need to be established with any mills being considered for the purchase of structural timber. Visual strength grading is a service that may be hired in.

Mechanically strength graded Scottish timber can be purchased from a number of the bigger sawmills throughout the country but some will only supply full palettes and it will almost certainly be most economical to order full lorry loads. The majority of home-grown softwood is given a C16 grade. C16 timber is the most common grade used in the UK, and homegrown timber achieving this status is, mechanically-speaking, equally fit for purpose as imported C16. Due to the increasing size of frames required to support greater depths of insulation, solid timber of lower grade is increasingly easy to accommodate in engineering solutions for a variety of timber frame types. (Technically it is possible to grade some Scottish softwood to C27 but this is not done commercially.)

B.2.2 Drying

There are essentially three categories of timber with respect to its moisture content: kiln dried, air dried and "green" (i.e. recently sawn). However, softwood is generally kiln dried to around 20% whereas hardwood is typically kiln dried to around 10% moisture content. A moisture content recommendation for different species and applications is given in BS EN 942.

Nearly all timber for internal applications should be dry and kiln drying is the usual way to achieve this. Not all small sawmills have this facility, so again it is necessary to establish this with possible suppliers. Moisture content will often be specified by an engineer, as timber does not achieve its full structural strength until dry. Timber that is insufficiently dry may distort and/ or crack as it dries in a building, with a range of more or less serious structural and cosmetic consequences.

There are however, a range of specialised construction methods that can use air dried and even green timber. For instance both the "green oak" frame building tradition and softwood log building method can utilise undried timber.

Refer www.argyllwood.co.uk/AGWA/agwahome.htm and Green Oak in Construction by TRADA (www.trada.co.uk). Furthermore, the large sections of timber often used in post and beam building are not always more than air dried when installed, especially for unheated buildings. Indeed, timber over 100mm thick cannot be effectively kiln dried.

It is generally considered that timber cladding should be either air or kiln dried to below 19% to minimise movement, but in practice it may rise a little above that once on site in Scotland. Larch cladding is sometimes deliberately installed quite green in order to try and prevent it from distorting while drying and to make nailing easier. However, nailing will not always prevent subsequent movement and screwing is more likely to resist the powerful forces generated by the drying timber. The need to allow for movement in cladding is discussed in section C.1.7.

Timber of greater than 100mm section such as these in a Neil Sutherland designed frame cannot readily be kiln dried and are often used air dried. Photo: Bernard Planterose



B.2.3 Treatment

A detailed description of timber durability and appropriate treatment is given in “Timber Cladding in Scotland” (Scottish Executive 2002) (<http://www.scotland.gov.uk/Resource/Doc/46910/0024271.pdf>) and the following is only a brief summary of it. The scope of the original covers the principles of treatment of all applications of timber (not just cladding) and refers to the authoritative British and European Standards. It is essential reading for those designing and building in timber in Scotland.

European Standard BS EN 350-2:1994 groups timbers into five durability classes based on natural durability of their heartwood against wood-destroying fungi. European standard 460 reviews durability versus five Use Classes (formerly Hazard Classes) and identifies when wood preservation is required. This “preservation” refers to chemical treatment under pressure or vacuum where the preservative is forced into the cell structure of the timber.

It is critical to note that durability classes refer to heartwood only. This is because all sapwood is rated as “not durable”. Oak is rated as “durable”, larch is rated as of variable durability from “moderately durable” to “slightly durable” and Douglas fir of British origin “slightly durable”.

Reading off the table given in BS EN 460 and reproduced in “Timber Cladding in Scotland”, it will be seen that the decision on whether to treat is not totally black and white. For instance, exterior cladding is generally considered as HC3 (re-named Use Classes) and the table shows that very durable and durable timbers do not require treatment in this application (red boxes). A moderately durable timber (such as larch) is given an orange box signifying that it does not normally require treatment in this application but it could be considered in particular situations. Even slightly durable species are given a yellow box for HC3 signifying a possibility of use without treatment but with several provisos.

Further information on which species of timber require treatment or coating when used as cladding will be found in Appendix D. However, it should be noted that some experience and judgement is required in this matter and, where in doubt, it will be better to seek advice from an experienced timber designer.

Many local sawmills in the Borders have treatment facilities, as a large part of their produce is for fencing and other outdoor uses. The most prolific local timber that takes treatment well is Scots pine which, when pressure/ vacuum treated, can be used for decking, cladding, outdoor furniture and other exterior uses. Some spruce is also treated in local sawmills but does not take preservative treatment quite so well and therefore does not have quite as high a durability as pine. It is sufficient for shorter-lived products such as tree stakes for instance.

B.2.4 Dressing and profiling

The majority of timber used in a building is dimensioned and dressed (i.e. planed to a precise dimension). This is required for all but the roughest framing jobs. Not all small sawmills have this facility, which tends to go with a kiln drying facility as timber is not usually dressed until dry. In order to produce profiled timber such as floorboards and profiled cladding, further equipment is required. Only a very small number of small scale sawmills have these facilities though joinery workshops invariably do.

B.2.5 Types of composite timber products

A number of composite timber products are manufactured in Scotland, some from home-grown material and some that include it. Products include OSB (orientated strand board), MDF (medium density fibreboard) and I beams. These products are generally procured through merchants though it is likely that a precise brand will have to be requested in order to procure Scottish or British material. There are many types of these products from many origins imported into Scotland but it is generally straightforward to locate the Scottish brands. It is not legal to specify brands in public procurement (see section B.4 below).

B.3 Timber Certification

Summary

Systems of timber certification have been developed to encourage sustainable forest management throughout the world and to facilitate purchasers in the responsible choice of sustainably grown timber. However, much timber is still harvested from uncertified sources. Many small growers in Scotland are not certified. Because all UK grown timber is governed by the UK Forestry Standard, all UK sourced timber should be acceptable even if not formally certified. However, certification should be sought for all timber imported to the UK.

B.3.1 Certification standards

The specification and procurement of sustainably grown and harvested timber presents some challenges because of the number of different certification systems. To assist public sector and larger building specifiers, the UK Government has set up the Central Point of Expertise on Timber (CPET). (<http://www.proforest.net/cpet>) CPET recognises only four systems as providing a guarantee of timber being both sustainable and legal:

- Forest Stewardship Council (FSC)
- Programme for the Endorsement of Forest Certification (PEFC)
- Canadian Standards Association (CSA)
- Sustainable Forestry Initiative (SFI)

In addition, CPET recognise the Malaysian Timber Certification Council (MTCC) as certifiers of legal (but not necessarily sustainable) timber.

It should, however, be appreciated that many small growers and suppliers of timber in Scotland who readily reach or exceed these standards are not certified by one of these bodies. These suppliers can be accommodated by the procurement rules which allow for other types of credible evidence of legal and sustainable forestry practices (refer to Category A and B type evidence in CPET website).

B.3.2 Certification and home-grown timber

Not all small growers and suppliers of timber can afford the expense of implementing certification procedures. Virtually all UK timber growers operate under government grant systems (administered by FCS in Scotland) bringing them under strict environmental and silvicultural standards. These standards are simply a condition of grant and very few operate outside the system. Over 70% of commercial forest area in the UK is FSC certified. This virtually guarantees that home-grown timber is sustainably grown and harvested, and its source is relatively easily verified. When purchasing timber from a local sawmill, it is often possible to ascertain precisely where the timber was harvested or through what supplier (e.g. Forest Enterprise or Scottish Woodlands, Tilhill, etc.). All Forest Enterprise grown timber is FSC certified.

Home-grown and Scottish timber supplied from government grant-aided woodland (which constitutes nearly all local supplies) is both sustainable and legal even where not so labelled.

B.3.3 Certification of non UK timber

About 80% of timber used in the UK is imported and most of that is softwood from Scandinavia, Canada and Russia. Increasingly large amounts of coniferous plywood are coming into the UK from China (about one third of the UK total). About 8% of timber is imported from the Tropics.

About 56% of imported timber volume in the UK is certified and of this 27% is under FSC, 28% under PEFC and less than 1% under all other labels. The greater proportion of certified sawn softwood entering the UK is PEFC labelled, reflecting the dominance of this label in Scandinavia. Unfortunately, only about one in ten users currently demand certified timber or timber products (2005 data).

It should be noted that parts of the global timber trade are highly contentious. The UK is said to be the importer of up to 10% of the global value of illegal timber i.e. timber from illegally logged sites or that has evaded the country of origin's taxation systems. Ref www.illegal-logging.info.

Certification procedures themselves have been criticised, particularly in Canada and Russia, and the validity of the MTCC as a whole has been questioned. Certification in these countries has been described as a mechanism by which larger companies have consolidated their land holdings at the expense of small local operators who cannot afford the certification costs. This 'market capture' has been described as the corporate perversion of public policy making.

Knowledge about the global timber market, coupled to an environmental design brief, will almost certainly lead to more sustainable sources within the EU and Scandinavia being favoured. Timber certification labels recognised by CPET will guide all decisions under public procurement rules, where foreign timber has to be allowed. However, for privately funded projects, it is worthwhile becoming familiar with the latest arguments and allegations on the web.

Norway bans all tropical timber

The Norwegian government does not recognise any tropical forest certification system as reliable and the Directorate of Public Construction and Property has therefore banned the use of all tropical wood, including certified wood in government funded schemes (from 2007). A Government statement reads: "The government wants to stop all trade with unsustainably or illegally logged tropical forest products. Today there is no international or national certification that can guarantee in a reliable manner that imported wood is legally and sustainably logged. Tropical wood shall not be used either in the building itself nor in materials used in the building process."

This example of unilateral government action serves to illustrate the contentious nature of some certification schemes and draws attention to a more discriminating approach to timber procurement that can only be operated within the EU by those outside the public procurement rules (Norway is not an EU member).

B.4 Timber Procurement Regulation

Summary

In the public sector, there are rules governing procurement that prevent the specification of 'local' or 'home grown' materials. The legislation is designed to ensure the important principles of fair and open competition within the EU. However, this can run counter to other European and national strategies that seek to promote stimulation of rural economies and the local sourcing of materials as part of rural development and to aid reduction of transport distances. In the private sector, the specification of certified and even home-grown timber is becoming increasingly common and this can assist in securing sustainable development objectives.

B.4.1 Private sector

Private sector clients can procure timber from whatever sources they choose. However, tender documents may require evidence of certification. Some organisations are introducing briefs that encourage sourcing of home-grown material where possible and schemes being audited under BREEAM may gain higher points for so doing.

B.4.2 Public sector

The situation in the public sector is quite different and the UK Government has developed a timber procurement policy which requires central government to actively seek to buy timber from legal and sustainable sources. Where a building project is in receipt of 50% or more of public sector funding, procurement practices must comply with European law and the policies of the UK government and European Union. (Many PFI contracts are also subject to the EU rules.) Even low value contracts above or below the 50% public funding threshold may require advertising and are then subject to the principles of equal treatment and proportionality (across the EU). Local Government, including SBC, is also encouraged to adopt this policy.

To comply with Scottish Government policy in publicly funded projects, it is essential to specify both legally and sustainably sourced timber, verifiable either by certification or other approved means. Where certified timber is to be specified, no preference may be shown for any one of the particular recognised schemes (see section B.3). There are further rules of procurement for public contracts that are concisely summarized in the Scottish Government publication "Sustainable Construction Timber" from which the following paragraph is taken:

A further complication arises because public sector specifications need to be based on measurable performance attributes such as size, strength or durability. It is therefore only permissible to specify a particular timber species when it can be shown that the technical characteristics of that species make it particularly suitable. This may require independent advice. Discrimination cannot, however, be made in favour of timber from a particular geographical source, nor can the specification nominate a particular product brand. Specific timbers or brands can be listed in a specification as examples of the type of performance required.

This legislation effectively makes it difficult for “public sector” schemes to favour home-grown material but there are opportunities within the system nevertheless which do not represent the “restrictive practices” which EU legislation seeks to prevent. For instance a public sector client is permitted to state a preference for the use of local material in the introduction to a tender though this must not form part of any advertising, specification or contract. Once a contract is awarded, the client is also permitted to invite the chosen contractor to consider the supply of locally sourced timber providing this would not involve any change in the contract, including price.

Many EU and national policies and strategies promote the use of local materials in general terms to support regional economies, reduce road miles and reduce CO₂ emissions. The public procurement rules may therefore appear to run contrary to this policy direction and it is conceivable that in time the emphasis or interpretation of these rules to more freely facilitate local sourcing may occur. In the meantime, it should be recognised that, to some extent, legislation hampers the ability of public bodies to take a lead in promoting and demonstrating the use of home-grown timber (and other materials) in their own building projects.

Appendix C

Designing with timber

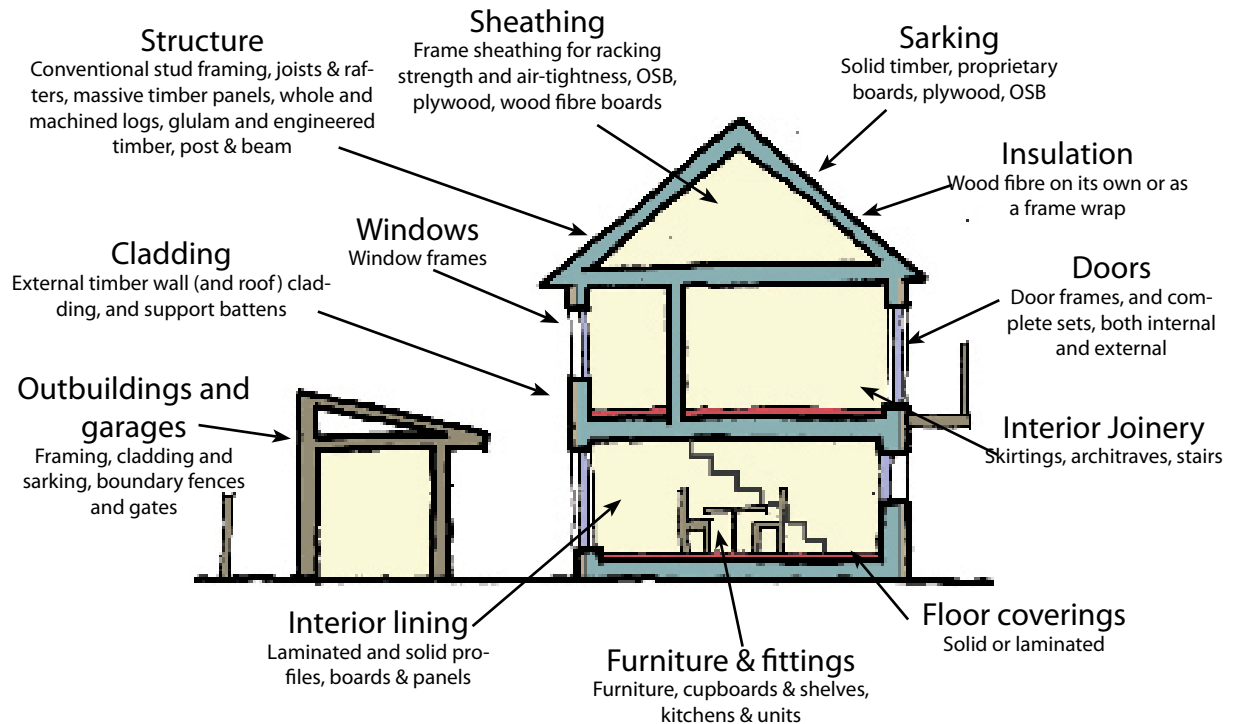
Homegrown timber used for structure, flooring, internal joinery, doors (and cladding) in a modern Borders house by Quercus Rural Design. Photo: Peter Caunt



Appendix C - Designing with timber

C.1 Timber in Different Applications

Timber in construction: used in almost every component and application



Summary

This section relates to the diagram above which draws attention to the wide range of parts of a building where timber or timber products can be used. It reminds us that buildings can be made almost entirely from timber (as demonstrated historically by the Vikings). This may become increasingly common in the future as we turn more and more to renewable and low energy construction materials. The vast majority of these materials are available as home-grown timber (see page four for definition of these terms).

C.1.1 Internal Joinery

Internal joinery includes a wide variety of non-structural and even decorative elements of a building that do not therefore require strength grading. They will also not require any preservative treatment other than possibly a stain or a more environmentally-benign natural plant based oil. It is thus possible to procure such timber readily from local sawmills throughout Scotland though the material should be well dried and preferably 'conditioned' to the environment in which it will be used. ('Conditioning' is the process of equalising the moisture content of the timber product with its intended service environment.)

Suitable timbers for internal joinery include almost any hardwoods and the harder of the softwoods such as larch, Scots pine and Douglas fir. Generally the softer softwoods such as spruce should be avoided as they damage too easily. As the timber will be dressed, it is also the case that the harder woods generally give a better finish more readily. Individual characteristics of timber should also be appreciated; for example, larch in small cross-section has a tendency to warp or bow (sometimes both), particularly when subjected to varying temperatures, e.g. adjacent to under floor heating or radiators.

Applications include skirtings, architraves and other trim which can be made with simple modern profiles with a minimum of machining. When the required sections of timber are small (i.e. less than 25 x 25mm), it is necessary to be more aware of loose knots which may cause lengths to become unfit for purpose and even to break. In this case, cleaner (i.e. more knot free) timber becomes the most important characteristic when choosing one material over another.



Beech stairs, ash floor and Douglas fir skirtings giving an interesting combination of colours and figuration in a modern Highland house by Neil Sutherland Architects.
Photo: Bernard Planterose

Innovation in timber jointing

As part of the Scottish Borders Council SBWS initiative, a new to Scotland timber jointing system has been introduced to a number of timber businesses. It utilises carbon steel dowels that self-drill through timber with up to 3 x 6mm steel flitch plates all in one go. The system replaces bolts and can make considerable savings in time when putting together large numbers of steel flitch-plated joints in post and beam construction. It has been used widely on the continent for some years.

Staircases can also be made from home-grown material but their design should avoid small sections such as those typically used for balustrades for the above reasons. An example of a staircase made from large sections of home-grown Douglas fir with steel tread brackets and a wire balustrade is illustrated on the next page.



A staircase in Scottish Douglas fir and steel in a contemporary design by North Woods Construction Ltd. Photo: Bernard Planterose

C.1.2 Internal Linings

Throughout Scotland it is possible to see examples of timber-lined interiors across the whole spectrum of building types. From the humblest of Highland croft houses, lined in tongue and grooved boards (so-called V linings) to oak panelled manses, lodges and castles, timber was historically the material of choice for interiors – though much of it was probably from foreign sources. Its use has become restricted in recent times because of the dominance of plasterboard in the marketplace and also because of changes in Building Regulations that make it harder to use timber in its untreated natural form as an interior material.

It is now appropriate to re-examine the use of timber as an interior lining and section C.2 explains how this can be done at the same time as meeting Building Standards in Scotland. The use of interior timber linings up to the limits set by the Building Standards is to be encouraged.

There are a number of suitable timber lining materials available. These range from simple profiled boards that slot together as in tongue and groove either to give a grooved face or a flush face like a floor board. A variety of creative surfaces can be achieved by good designers, especially in combination with sheathing materials such as Oriented Strand Board (OSB) or plywood. Both softwoods and hardwoods can be considered but all materials will need to be well dried.

Case Study

The ceiling of the Glencoe Visitor Centre by Gaia Architects utilises an un-nailed board system where the boards are held together by a screwed clamping board allowing short lengths of timber to be used – in this case of home-grown birch. A similar system is used for the home-grown oak floorboards.



The ceiling of the Glencoe Visitor centre utilizes home-grown birch in an un-nailed system. Photo: Bernard Planterose

C.1.3 Flooring

Flooring is an area of buildings that often presents very difficult choices to environmentally aware designers. A wide range of laminated timber floor coverings are available, frequently comprising timbers from different parts of the world. These invariably have high embodied energies and are seldom entirely of certified timber. On the other hand, many solid timber floorings are also of uncertified and/or much travelled timber. The better environmental choices are (a) European hardwoods such as oak or chestnut which are invariably from well-managed woodlands or (b) certified softwood boards (often from Scandinavia) such as those readily available from builders' merchants.

Solid flooring can be made from home-grown timber and there are small workshops from the Borders to the Highlands with experience. Whilst oak, beech or ash may be the species of choice in hard wearing areas, Douglas fir and larch have both been used successfully in domestic situations. Only the best material should be used and well controlled kiln drying is critical, to achieve the desired quality.

Floor of home grown ash, sourced and machined in the Highlands by Neil Sutherland Architects. Photo: Bernard Planterose



Floor of home grown elm, sourced and machined in the Borders by Abbey Timber. Photo: Willie Dobie



C.1.4 Windows and Doors

This is perhaps the most demanding of all applications for the use of timber and requires the highest of quality to avoid deflection and movement. For this reason, windows and doors are most frequently made from glue-laminated timber to give exceptional stability. There are a number of Scottish manufacturers making high quality windows and doors from imported (often Scandinavian) softwood and this represents a good environmental choice. Interior doors are relatively simple and can be made from kiln-dried, home-grown softwoods or hardwoods.

Inevitably such items require skilled labour and it is hard for small joinery workshops to compete with imported factory made goods. However, if budget permits, they may be considered as part of a strong environmental design.

C.1.5 Insulation

Wood fibre insulation is an environmentally sound material much used in Europe but it is quite expensive in Scotland as it has to be imported, at this time. Rigid and semi-rigid boards of greatly varying thicknesses are available including tongue and grooved types, chosen for their air-tightness. They are often used to 'wrap' timber frames and massive timber structures to almost eliminate thermal bridging.

C.1.6 Structure

The use of solid timber in structural applications as it is affected and regulated by Building Standards is introduced in Section C.2.2 below. OSB is made in Scotland from home-grown material and this has become an important structural part of timber frame design both as sheathing and sub-flooring.

The use of home-grown timber by timber frame manufacturers in Scotland has been very limited to date in comparison with imported timber, predominantly from Scandinavia and the Baltic States. The main driver for this trade has been relative costs but the allegedly lower quality of Scottish timber has also been a factor. With improvements in grading and processing, home-grown material may begin to gain a greater market share and it is possible that rising transport costs and a closer assessment of embodied energy of construction materials may further promote this. However, there is currently only one major timber frame company in Scotland using Scottish timber for their standard kit product.

Two exemplar trial projects have been carried out, as part of the SBWS implementation, based entirely on Scottish timber within 'standard' timber frame types; one of which was in collaboration with a Housing Association. Such bodies are increasingly showing interest in using home-grown timber as part of their growing commitment to reducing the carbon footprint of their projects and supporting local economies.

Self-builders and joinery companies 'stick building' or making their own frames on a 'one off' basis have the option of ordering home-grown material from one of the larger Scottish sawmills who will generally supply in full pallets or lorry loads.

Post and beam framing methods have developed to fulfil a niche market in Scotland in the last 20 years and much of this work has exploited the qualities of, home-grown timber. Traditional post and beam framing generally utilises oak and relies on peg and dowel jointing systems. This tradition is alive and well in the UK and more than one Scottish business offers it. However, a 'version' of the same structural type has evolved to use steel bolts, sometimes in combination with steel flitch plates, offering a more economic solution that has gained ground in Scotland both in the domestic and larger building types such as offices and visitor centres.

At Findhorn Eco-village and elsewhere, a hybrid of post and beam with stud framing has been very successfully utilised in house types and offers excellent opportunities to incorporate large sections of home grown softwood or hardwood to create more interesting and beautiful interiors. Post and beam structures are typically open to the ceilings with no trusses and easily accommodate internal balconies and large areas of glazing. Douglas fir and larch have been favoured in Scotland as readily available home-grown softwoods of good structural strength, workability and characterful finished appearance.



A post and beam frame designed by Neil Sutherland Architects in Scottish Douglas fir under construction. Photo: Neil Sutherland Architects

Log construction is making a revival in Scotland as it can utilise home-grown timber and fixes significantly more carbon in its structure than almost all other building types (refer A.3.2 above). Even a single storey 25m² footprint building can utilise over 20m³ of timber. As the sapwood is not removed in whole log (scribed log) building techniques, the natural durability of logs is not the primary concern. The exterior walls of all softwood logs will need preservative impregnation unless of durable heartwood only (i.e. machined logs). In wet climates, log buildings require large overhanging roofs and/or further exterior timber cladding to protect walls as much as possible from precipitation. Logs need not be stress graded as they are not subject to a significant bending moment (unless used in the roof construction). This specialised form of construction takes experience and a high level of skills but only simple tooling.

A relatively new form of timber construction in Britain is so-called “massive timber” (refer A.3.2 above). Glue-laminated and timber dowelled varieties (Brettstapel) exist and both are used to form large solid timber panels. They utilise relatively low grade softwoods and can incorporate higher grades of timber on their inner surfaces to provide the required finish. They are used to make walls, floors and roofs and allow very rapid construction speeds. They also fix large amounts of carbon in their massive structures and often utilise rigid wood fibre insulation attached externally, further increasing this quantity. At the time of writing, at least two factories have expressed real interest in developing manufacturing capability for this system in Scotland using home grown softwood. In the meantime it is possible to import European-made panels from certified sources.



Cross glue laminated solid timber panels are a type of massive timber that is widely used throughout Europe and Scandinavia. Here, an entire wall of one storey is being craned into place for a house in London. Architect: David Adjaye. Photo: Eurban

Heartwood vs. Sapwood

The stems of trees comprise an inactive central core known as heartwood (or duramen) and an active outer layer known as the sapwood (or alburnum). In a living tree the parenchyma cells are actively conducting nutrients in the sapwood but they are dead in the heartwood. Before they die they usually produce oils, gums, resins and tannins which saturate the cell walls giving the darker colours and conferring resistance to bacterial and fungal attack. In some species the colour differentiation is strong (e.g. in larches and Scots pine) making it easy to grade out the sapwood from the heartwood in processing operations. However, there is very little difference in spruce for instance. Whilst the sapwood of all species will decay quite rapidly when moisture exceeds 20%, heartwood is generally more durable. The European Standard BS EN 460 groups the heartwood of timber species into five durability classes and a table giving these classes for commonly used cladding species is reproduced in the Scottish Government's "Timber Cladding in Scotland" along with other relevant detail.

Timber Preservation and Surface Treatments

There is a fundamental difference between a) the treatment of timber with preservatives by pressure, b) vacuum impregnation in a controlled industrial process and c) the application of a very wide variety of surface coatings applied by brush, spray or roller. In the case of a and b the chemical preservative is forced into the cells of the timber generally achieving penetration throughout the sapwood. Such treatment is said to increase the service life of timber by 5-10 times depending on species and application. The chemicals used act as general biocides, conferring resistance to fungi, bacteria and insect attack.

In the case of c, treatments applied to the surface of timber generally achieve little or no penetration and have widely varying constituents with equally varying toxic effects on the agents of decay. They do however, reduce the rate of decay through helping to shed water from the surface more quickly. They all depend on the surface film of paint or stain remaining in tact and all therefore require maintenance at intervals that will vary widely from elevation to elevation depending on exposure and sunlight.

C.1.7 Timber Cladding

As described in Part 1, there is a significant increase in the amount of timber cladding being used in Scotland. (The volume of timber cladding sold in the UK has nearly doubled every two years in total since the turn of the century.) There is considerable potential to increase this further with the concurrent benefits already described.

Authoritative literature on the use of timber cladding in Scotland is already available and reference should be made to the Scottish Government's "Timber cladding in Scotland" (<http://www.scotland.gov.uk/Resource/Doc/46910/0024271.pdf>) and "Designing the Timber Façade" (in preparation at the time of writing). This guidance is intended to complement those publications by providing more specific information on local availability and presenting design guidance, based on consideration of local built examples and the best of contemporary cladding from other regions.

The function of timber cladding when used as the external skin of a timber framed building is to prevent precipitation from reaching the frame. A ventilated cavity behind the cladding allows the free movement of air which is absolutely essential to the drying of the cladding and its supporting battens. In a modern timber frame construction, the water resistant (but vapour diffusive) membrane between the cladding battens and the sheathing of the frame is also an essential component. Under extreme weather conditions, some water may penetrate timber cladding and the membrane then acts as a second line of defence. It can also deal with condensation forming anywhere in the cavity.

The contemporary development of timber cladding design has focused on increasing the longevity of the materials and both reducing and facilitating its in-service maintenance requirement. The central principle is now well established i.e. that the greatest longevity is achieved where timber cladding is detailed to maximise air flow around all its edges and faces to allow rapid and complete drying. This same principle of separation of timber has the simultaneous effect of allowing easy removal of defective boards or trims when necessary. In addition, the end grain of cladding boards should never touch any window reveals or cladding dividers and edges should be left clear of drips and sills.

Various types of open cladding are gaining in popularity in Scotland taking the lead from Europe. In this residential example in the Borders over-size boards have a separation of around 15mm and windows do not exhibit reveals. Architect: Icosis. Photo: Bernard Plant-erose



Fixings used for cladding must not corrode and stainless steel nails or screws or hot dipped galvanised nails are the preferred choice (electro-galvanised nails perform less well). The main factor causing corrosion is moisture and above 20% moisture, all timbers release acetic acid by the natural breakdown of cellulose. This corrodes metal. Even below 20% moisture, acetic acid is present although more in some species than others. The heartwood of eucalyptus, oak, sweet chestnut, western red cedar and Douglas fir are all notable for their relatively high acidity and therefore aggressiveness to metal fixings. Stainless steel fixings should always be used with these species. Galvanised nails can be used on other species where the cladding is to be painted but these often leave unsightly staining; on fresh larch for instance. Proprietary cladding nails are available with annular rings for pull out resistance. It is also useful to note that blunt nails are useful for reducing splitting of boards. If using a nail gun, the pressure should be set to ensure the nail heads rest on, but do not penetrate, the surface of the cladding. The use of lower quality timber for cladding can result in significant variation between the quality of individual boards. In turn this can make using nail guns difficult as the setting for one board may be too much, or too little, for the next one.



Contrasting approaches to timber treatment seen at Findhorn Eco-village. The house on the left is being left to weather naturally whilst its neighbour takes a 'retro' Scandinavian approach with brightly coloured, opaque paint to all exposed timber. Photo: Bernard Planterose

It is often the treatment, either surface coating, pressure impregnation or both that is the subject of greatest debate when designing timber cladding. Whilst the guiding principles are established by BS EN 350-2 and BS EN 460, there is still room for individual interpretation and this varies widely. The preference for untreated and uncoated timber cladding in Austria, for instance, contrasts markedly with the colourful buildings of Norway and Sweden. This can be explained by the availability of naturally durable larch in central Europe and the reliance on Norway spruce and Scots pine in Scandinavia.

In Scotland, both untreated and treated cladding is used and there is no one prevailing style. Currently a lot of Siberian larch is being left to weather naturally and it remains to be seen how this will perform and look. A great deal will depend on detailing, exposure and on extent of roof overhangs. One consideration is the differential weathering and therefore colouration that takes place over time where roof overhangs are present. After a few years untreated timber will vary from golden in protected eaves areas to dark grey at the base where timber may even be in a zone of splash-back.

Of the home-grown softwoods, only heartwood of larch may be considered for use, uncoated and untreated. For all other home-grown softwoods, either a pressure treatment and or a surface coating will be required to achieve a reasonable level of durability. Despite common opinion concerning the three different types of larch available in Scotland, (Japanese, European and hybrid) recent science demonstrates that all three are of similar durability providing a relatively old tree is available (refer forthcoming CTE report). Japanese larch has often produced inferior material due to its form and young age at harvesting. It should also be noted that UK grown western red cedar is not as durable as Canadian grown material and is of variable durability broadly similar to the situation with larch. Hardwood claddings of oak or chestnut may be used untreated.

From a purely ecological viewpoint, all treatments are toxic to some degree, whether surface applied or pressure impregnated. On these grounds, untreated larch is the preferred cladding. However, the availability of larch in the Borders is restricted and its availability is becoming limited. Other timbers are therefore a realistic alternative and both Scots pine and Sitka spruce are readily available from local sawmills. Methods for treating these for cladding purposes are discussed earlier in this section (refer box p42, 'Timber Preservation and Surface treatments').



Untreated home-grown European larch turning silver on house in Borders. Architect: Sally Ruel. Photo: Sally Ruel

While cladding may be surface treated on site after installation, a more thorough job can be done by workshop coating where all four sides can be treated - providing that required lengths are known. Pre-coating also ensures that, where cladding shrinks after installation, it does not expose uncoated areas. Ends of boards exposed on site by cutting to length will require site coating before installation.

As seen in the examples in Appendix F, both vertical and horizontal cladding patterns are in use in Scotland today. It is worth remembering that where vertical cladding boards reach the base of a building, it will be necessary to replace the whole board

when eventually they do start to rot. A horizontal pattern in the lower, 'splash' zone of a building can be a good idea as it allows the bottom few boards to be easily replaced independently of the rest of the façade. Combinations of both types on the same building are quite possible as will be seen in some of the examples that follow. An increasingly popular use of timber cladding is as a band of material above a rendered, lower wall finish. If 'green' (i.e. unseasoned) larch cladding is to be used in this situation, designers should be aware of the potential risk of resin weeping from the cladding. Although uncommon, once settled in the render the resin is extremely difficult to remove without leaving marks on the render. Invariably this requires over-painting of the render. Solutions to this problem include: using seasoned larch cladding; specifying an alternative species of timber for cladding, and; avoiding the use of timber cladding immediately above any surface that would be detrimentally affected by resin weeping onto it.

The use of timber shingles as both cladding and roofing also requires special mention as imported western red cedar has been used in these applications in Scotland. This material almost always originates from the west coast of Canada with the large embodied energy that implies. Some is still coming from old growth forest and some from territory with disputed land rights. (www.firstnations.eu) Cedar shingles utilised in the UK are nearly always preservative treated due to the higher decay risk than in more continental climates. A very small number of projects have been completed in recent years in Scotland using untreated larch or oak shingles of home-grown origin. It remains to be seen how they perform.



Larch shingles in combination with white render on a contemporary house in Midlothian. Architect: Icosis. Photo: Icosis

C.2 BUILDING STANDARDS FOR TIMBER

Summary

There are a number of Scottish Building Regulations for fire protection in relation to timber in its various uses as structure, external cladding and internal linings which must be considered from the outset of a project. Local Development Control departments encourage early discussions in order that any potential problem areas can be identified and resolved before minor issues become major ones.

This section describes the implications of the Scottish Building Regulations and Technical Standards (<http://www.sbsa.gov.uk/>) on timber design. An understanding of the Standards and Regulations is basic knowledge for designing any building and the relevant areas are identified below. Because it is combustible, there are three areas where timber has its own set of regulations which are different from those for non-combustible materials. These areas are timber as interior lining, timber as structure and timber as external cladding.

C.2.1 Standards for timber as interior lining

Timber is classified as a high risk material for internal lining. Clause 2.5.1 in the Domestic Technical Handbook is the key regulation in respect of fire:

"In a room (other than a kitchen) more than 4m², the wall surfaces may ... have a high risk classification subject to a maximum of 20m² where the total area of the high risk surfaces is not more than half the floor area of the room."

The ceiling does not count in the calculation so you could have a timber ceiling and up to 20m² of timber wall lining in a room with a floor area of 40m² - in a squarish room this might mean only one of four walls.

There are three strategies that can be adopted to increase the amount of timber lining whilst satisfying the fire regulations. These may be relevant to a new generation of exposed massive timber panel buildings. They are: 1) fire sprinklers, 2) flame retardant coatings, and 3) a fire engineering approach.

Fire sprinklers have long been used in public buildings but are becoming more commonplace in domestic buildings. Discreet semi-recessed sprinkler heads are available and whole house solutions are reasonably competitive compared with the costs of lining out in plasterboard.

Flame retardant coatings have also been available for some time but mostly as rather thick, creamy surface coatings. A new generation of surface applied treatments are now available that penetrate the surface of the timber and can even be over-coated with colour stains. These are said to be more environmentally acceptable and much less toxic.

A fire engineering approach to the design of buildings can be used to demonstrate that occupants will be able to escape a building safely before the fire becomes life threatening. This approach adds to the design fees of a project but can save money in terms of a reduction in fire fighting equipment that may be required within a building.

C.2.2 Standards for timber as structure

There are two aspects of timber as a structural material requiring a knowledge of Building Regulations: (1) structural integrity and (2) fire protection. Strength grading has already been introduced in Appendix B (B.2.1). The relevant sections of the Building Regulations for fire protection in relation to structure are 2.2 and 2.3 in the Domestic Handbook and 2.1, 2.2 and 2.3 in the Non Domestic Handbook. BS EN 1995 Eurocode 5: 'Design of Timber Structures' gives three fire resistance issues which may need to be addressed. (1) resistance to structural failure (2) resistance to fire penetration (3) resistance to the passage of heat.

Building Standards currently refer to both Structural Eurocodes and British Standards in relation to structural integrity which is covered by Part 1 of the Technical Handbooks. (BS will be withdrawn after 2010.) In practice this requires the services of a structural engineer to provide the necessary design information. In the case of timber kit frames and other pre-fabricated buildings, the engineering is almost always provided as part of the sale package and price. Where a building is individually designed, the structural engineering will often be supplied as a separate design service. The structural design will usually carry an SER certificate (Structural Engineers Registration Ltd) (<http://www.ser-ltd.com/>) which will be presented to the Local Authority as part of the Building Warrant application.

C.2.3 Standards for timber as exterior cladding

Regulations that deal with the use of timber as an exterior cladding relate to durability and to fire safety. The latter divide into three topics: (a) fire spread on the façade (b) fire spread from an adjacent building (c) fire spread within cavities. The key documents which should be referred to are: Scottish Building Standards Technical Handbooks – Domestic Part 2 and Non-domestic Part 2 which deal with all aspects of Fire. The Scottish Government publications “Timber Cladding in Scotland” and “Designing the timber façade” are both excellent in interpreting the regulations and giving practical advice.

(a) Surface spread of flame across cladding of a building

Timber cladding is installed on battens (and sometimes counter-battens) to provide free drainage and ventilation between it and the structural wall. This creates a cavity that can facilitate the spread of flame up and across a building. This can allow a fire to jump from storey to storey through windows and other openings. To combat this, the Building Regulations require the installation of cavity barriers to slow down that potential fire spread. The critical clauses are:

Cavity barriers -

“In order to inhibit fire spread in a cavity, every cavity within a building should have cavity barriers with at least short fire resistance duration (see annex 2.B) installed around the edges of the cavity. This includes, for example, around the head, jambs and sill of an external door or window opening.” and,

Dividing up cavities -

“Every cavity should be divided by cavity barriers so that the maximum distance between cavity barriers is not more than10m where the cavity has surfaces which are medium, high or very high risk materials.”

(b) Spread of fire between adjacent buildings

Key clauses in the Domestic Handbook, for instance, are 2.6 (spread to neighbouring buildings), 2.7 (spread on external walls) and 2.8 (spread from neighbouring buildings). The regulation for the design of external walls varies depending on the distance to the property boundary. Where that distance is 1m or over, clause 2.6.3 provides the basic rules:

“The amount of unprotected area (in square metres) may be equivalent to six times the distance (in metres) to the boundary. Therefore if the distance to the boundary is at least 1m, the unprotected area should not exceed 6m², if the distance to the boundary is at least 2m, the unprotected area is 12m², and so on. Where the external wall of a building is more than 6m from the boundary, the amount of unprotected area is unlimited.”

Timber does not attain a “short fire resistance” standard and therefore classifies as forming an “unprotected area”. Where an external wall is less than 1m from a boundary it will need to be non-combustible. In the context of designing timber-clad buildings, it may sometimes be appropriate to utilise a non-combustible fibre cement cladding which can be used to complement ‘real’ timber cladding amongst more tightly spaced developments. (N.B. Most of such products are only available in certain patterns which may be hard to match with other cladding.)

(c) Durability

The assessment of durability for cladding is covered in section C.1.7. An introduction to the specification of treatments and coatings is given in Section B.2.3. The Scottish Building Regulations rely on BS EN 350-2 and BS EN 460 and their interpretation. There are no other relevant regulations and designers should abide by the above Standards at all times. There are five steps:

- (1) select the timber species with regard to its natural durability and Use Class
- (2) treat or coat it according to the same tables
- (3) detail the cladding using best practice and taking account of exposure and other details of local climate
- (4) keep cladding at least 150mm above finished ground level and preferably more
- (5) design for easy maintenance.

Timber cladding less than 150mm from finished ground level is prone to rot and does not adhere to the British Standard. Photo: Bernard Planterose



A good solution to keeping timber off the ground and out of the splash zone is the use of a masonry perimeter foundation wall. Photo: Bernard Planterose



C.2.4 Professional design input

A structural engineer will nearly always need to be involved in the design of a timber building. The engineer will provide a variety of information including dimensions for all structural timbers and a structural strength grade (see B.2.1: Strength grading) as well as jointing details and information on species, moisture content and protection from spread of flame. The engineer will contribute to a building method statement and draw attention to Health and Safety aspects of the construction process and the final use of the building including its maintenance.

The responsibilities of the architect will be the same as for any building. Particular attention with regard to durability and combustibility issues will be needed. The architect will normally detail the exterior cladding which will play a major part in its durability and maintenance requirements.

Building Regulations are constantly evolving and the professional designer will keep abreast of these changes. The rapid advance of technology sometimes leads to a situation where there appears to be either (a) a lack of specific regulations or (b) some interpretation is required. In such situations, the Local Building Standards Manager will make this interpretation and it will be important for the Design Team to be aware of supporting precedents either elsewhere in UK or within the European Union. This will usually help to ease a new concept or material through the Building Control process so long as it has a European accreditation.

Appendix D

Timber for Cladding: A Species by Species Approach

Siberian larch cladding with high quality paint finish used to create simple domestic forms.
Architect: Oliver Chapman Architects. Photo: Oliver Chapman Architects.



Appendix D - Timber for Cladding: A Species by Species Approach

As will be clear from the previous sections, a variety of timber species have been used as exterior cladding in Scotland over the centuries and a wide variety remain in service throughout Europe and Scandinavia. A careful study of the historical performance of these in varying climates along with recent research tells us a great deal of what is appropriate today in Scotland. Both softwoods and hardwoods may be used but softwoods have become prevalent largely due to their more ready supply and lower price. Of hardwoods, the principle species currently specified for cladding is oak.



Untreated oak cladding in combination with local field stone on a house in the Borders.
Architect: Sally Ruel. Photo: Sally Ruel

OAK (*Quercus robur* and *Q. petraea*)

Oak, a traditional framing and cladding timber in Europe is re-gaining ground as a cladding of choice in higher specification projects and, although the material may potentially be procured in Scotland, it is most usually procured from France. Oak is grown and harvested from sustainable sources throughout France (many of which are not certified however) and contributes to that country's varied and bio-diverse landscapes. When specifying Scottish oak it is necessary to consider the quantity required in relation to the current available resource. A demand for this species should in theory stimulate the planting of woodland with oak which is a highly desirable element of the Scottish woodland ecosystem and landscape. Oak must be installed with stainless steel fixings due to its high acetic acid content that will corrode other metals. Screw cups are also sometimes used in the highest specification work and may assist de-mountability at the end of service life.

OTHER HARDWOODS (e.g. *Castanea sativa*, *Ulmus procera* and *U. glabra*)

Other hardwoods available in Scotland that can be used as cladding include sweet chestnut and elm and there are a small number of examples of the latter in use today (for instance East Lothian Estates buildings at Harestanes). However, whilst sweet chestnut is naturally durable, elm is not and requires surface treatment. It should be noted that some common hardwoods such as birch are distinctly non-durable in exterior situations.

CEDAR (*Thuja plicata*)

As noted above (C.1.7), western red cedar is imported from the western seaboard of Canada although small quantities are available from the UK. It has been a major timber cladding species throughout the last century on account of its natural high durability. Despite this quality it has generally been used in Scotland with preservative treatment. This is not required unless cedar is used on roofs. Due to the large transport distances associated with cedar, it does not score well in terms of embodied energy in comparison with home-grown or Scandinavian timbers. Furthermore it has been historically sourced from land traditionally occupied by native Indian peoples, and there has been much debate surrounding both the legality and environmental responsibility of this. The species is grown in small quantities in the UK but see C.1.7 on its relatively lower durability.

NORWAY SPRUCE (*Picea abies*)

Norway spruce is the traditional cladding material of Norway and much of northern Scandinavia but is traditionally painted or surface treated in Norway, Sweden, Finland and Iceland. This tradition has been transferred, for example to Shetland where historically strong trade links have resulted in a strong Nordic influence. Although this species is grown throughout the UK, climatic conditions here result in faster growth than in northern Scandinavia and this can lead to inferior mechanical properties. Whatever its provenance, it is not naturally of high durability and surface coating is recommended. (Note Devici building in home-grown Norway spruce in “Timber Cladding in Scotland”.)

SITKA SPRUCE (*Picea sitchensis*)

Sitka spruce is the most commonly available softwood in Scotland but is not generally used for cladding on account of its low natural durability. Recent trials however have been conducted to establish more scientifically its suitability as a cladding material. Evidence is now coming forward to suggest that, painted or treated, its performance may match that of home-grown pine or Norway spruce in terms of durability.

SCOTS PINE (*Pinus sylvestris*)

Scots pine, Scotland’s only native conifer tree species other than yew, is also the most widespread of all tree species in the northern hemisphere and has been a major component of construction throughout that region for centuries. It has a strongly differentiated heartwood and sapwood, the former of which is moderately durable. The reddish colour of its heartwood gives the material its common (and confusing) trade name in the UK – redwood. It can be used for cladding but Scottish material is generally pressure treated as the sapwood is not durable. As the sapwood often comprises the majority of home-grown logs, there is not the luxury of discarding this. The much slower grown material from more continental Scandinavia has a far higher heartwood to sapwood ratio and is therefore more economically utilisable.

DOUGLAS FIR (*Pseudotsuga Menziesii*)

Like Scots pine, the timber of Douglas fir has a strongly differentiated heartwood and sapwood with the former displaying an attractive red colour that deepens considerably over age. Whereas the heartwood of trees grown in its native Canada and western USA is rated as moderately durable, Scottish grown material may only be rated as 'slightly durable'. In practice this means that even well-graded, home-grown boards will need a surface coating to ensure a good service life as cladding. However, it is the case that, with the exception of larch, home-grown Douglas fir does offer a superior performance than the other home-grown softwoods when only treated with a surface coating. Furthermore it displays a stability and ease of machining that makes it an attractive material for profiled cladding.

EUROPEAN, JAPANESE AND HYBRID LARCHES (*Larix spp.*)

European larch has been traditionally used in Scotland for boat building and other exterior uses such as fencing on account of its natural durability. The two species of larch grown in Scotland (European larch *Larix decidua* and Japanese larch *Larix kaempferi*) along with their hybrid (*Larix x eurolepis*) are all classed under the European Standard (see B.2.3 above) as of variable durability ranging from 'moderately durable' to 'slightly durable'. As noted above (C.1.7), it is therefore the only home-grown softwood that can be considered for use as an uncoated and untreated cladding or external timber. It is commonly considered that European larch is of superior quality to hybrid and Japanese but recent studies have shown that variation in durability in all larch timber is mostly dependent on the amount of juvenile heartwood relative to mature heartwood. The age of harvesting may therefore be the most important consideration - all other site factors being equal. Whatever species is used, it is an important consideration in specifying larch that only the heartwood is used for exterior cladding and other external applications if it is to remain untreated as, in common with all softwoods, the sapwood is not durable. A reasonable specification for cladding to be left untreated is that the face of the boards should be entirely free of sapwood but some may appear on reverse sides. As noted in C1.7, unseasoned larch cladding has the potential to release resin once installed. As the resin is extremely difficult to remove, and will likely mark any static surfaces that it settles on, the location of larch cladding in relation to other cladding materials should be carefully considered at an early stage by the designers.

SIBERIAN LARCH (*Larix sibirica*)

Siberian larch has only become readily available in recent years in Scotland and has gained rapid ground as a cladding material on account of its relatively knot free appearance. Tests show that it has similar durability to the other larch species. Clearly, in terms of distance travelled and therefore embodied energy, material from as far afield as Siberia does not score well in an environmental audit compared with home grown material. Furthermore there are major concerns over the environmental sustainability and socio-political implications of forest management in many parts of Russia where even the procedures of the major timber certifiers have been challenged. It should be considered that a percentage of this timber reaching our markets is from old growth forest (www.greenpeace.org gives several papers and video clips on illegal Russian and Finnish timber operations).

MODIFIED TIMBERS

A range of relatively new products are entering the market utilising wood modifying technologies aimed at enhancing durability. These technologies include thermal modification (e.g. Thermowood, Lunawood, etc.) and chemical modification. As well as increasing durability, these technologies have been found to improve dimensional stability which in turn will improve longevity of any surface applied coatings. In Scotland BSW is the exclusive supplier of Accoya which is the trade name for New Zealand radiata pine acetylated to 20% weight percentage gain. In Scotland BSW claim a minimum service life of and offer a guarantee of 50 years. It is best surface coated as its through colour is otherwise a dark brown and such coatings may have up to a 10 year maintenance interval. At present it costs between 2 and 2.5 times as much as untreated softwood cladding.

'Visorwood' and 'Kebony' are both brand names of the Norwegian company Kebony Products AS and both utilize "bio-polymer impregnation" technology known scientifically as furfurylation. Kebony is now produced using both Scots pine and hardwoods and, as a cladding, claims a maintenance free service life of at least 30 years. Like Accoya, these products exhibit a dark brown colour which can be left to weather naturally or be overcoated with an opaque micro-porous finish.

Such products will help to increase the service life and therefore popularity of timber cladding considerably in the coming years. However, the advantages they offer should be evaluated in terms of embodied energy and other environmental criteria against locally grown material with a minimum of processing and treatment. In practice, both extremes of approach will have their place.

TROPICAL TIMBERS

The use of tropical timber species for cladding is considered to be inconsistent with the aims of this SPG and is therefore not covered here (see box p32, "Norway bans all tropical timber").

Appendix E

Timber for cladding: Cladding profiles

Homegrown, board-on-board larch cladding with simple, profiled fibre cement roofing combine to reinterpret Highland vernacular housing. Architect: Neil Sutherland Architects. Photo: Neil Sutherland Architects.



Appendix E - Timber for cladding: Cladding profiles

A wide variety of cladding profiles have been used in Scotland and throughout Europe and the following list is not intended to be exhaustive. It shows the prevalent contemporary types in Scotland.

Board on Board vertical

Utilises simple, unprofiled boards which are usually straight 'off the saw'. The simplest variation of this type is where all boards are the same dimension and fixed in two layers so that only front boards display the full width of board. This is typically 150mm but could be as narrow as 100mm. With this system it is important to align the boards correctly so that the natural 'cup' of the boards is towards rather than away from each other as they weather. This is especially important where this form of cladding is to be used in exposed locations or on roofs, and could lead to complete failure of the cladding if not taken into consideration.

Another version places a relatively smaller width board as the back layer compared with the front. For instance, 150mm boards with just a 10mm gap on the outer layer could be backed by 60mm boards behind.



Figure 1 : 150 x 18mm on 150 x 18mm with 100mm gap on front face, off saw, untreated.



Figure 2 : 150 x 22mm on 60 x 22mm dressed front face only, with 10mm gap on front face, untreated



Figure 3 : 150 x 20 on 60 x 20mm with 10mm gap on front face, off saw untreated



Figure 4 : 150 x 18 on 60 x 18mm with 9mm gap on front face, dressed three sides and stained

Batten on board vertical

In this configuration, the gaps between relatively wide boards (say 150mm) in the back layer are covered by relatively narrow (say 50mm) battens in the front layer. As with board on board, the material is most often straight 'off the saw' but it could be dressed and or treated if desired.



Figure 5 : 70 x 18mm on 150 x 18mm with 80mm gap on front face, off saw, stained. Used here to make timber shed doors.

Feather edge

A relatively simply-machined tapering profile for horizontal cladding where boards overlap one another by around 15mm. Although not entirely necessary, a specially shaped vertical support batten is often used on the continent to ensure that lines are kept perfectly horizontal and overlaps consistent.



Figure 6 : 150mm feather edged boards, with a face of 135mm, off saw, painted.

Shiplap

A slightly more sophisticated version of feather-edge where the horizontal boards are not only tapered but also have a rebate on the bottom edge to receive the thinner top edge of the board below.



Figures 7 & 8 : 150mm ship lapped (feathered) boards, with a face of 135mm, off saw, untreated.

Weatherboard

Overlapping horizontal boards of regular width with no taper or profile. The boards could be sawn on all four sides or left with one 'waney' edge for a very heavy rustic appearance.



Figure 9 : 150 x 20mm straight edged boards simply overlapped horizontally, with a face of 135mm, off saw, painted.



Figure 10 : 25mm depth off saw elm boards with one waney edge, simply overlapped horizontally and treated with creosote.

Profiled

A wide range of profiles have been used for both horizontal and vertical cladding. To be successful, all of these have to allow for movement, shrinkage and swelling of the timber. To do this, they rely on gaps of 2-3mm between surfaces. To achieve such precise profiles, clearly requires the use of well dried and dressed timber and therefore they are not available direct from the majority of sawmills.



Figure 11 : 125mm finished face, 20mm deep, fully profiled and dressed boards, stained.



Figure 12 : 125mm finished face, 20mm deep, fully profiled and dressed boards, before corner piece installed.

Open cladding

These systems are gaining in popularity and allow a relatively free movement of air between horizontally laid boards. The defining characteristic is that no part of one board touches any part of its neighbour. Some systems utilise a profile that gives a very similar appearance to a conventional overlapping profile yet in reality maintains around a 5mm complete separation (see example p41 Timber Cladding in Scotland). Other systems display a very overt gap and utilise a much 'chunkier' but narrower faced profile. In parts of Europe the profiles are sometimes rectangular, most often trapezoidal and utilise a clear gap of between 5 and 10mm. Such open systems are not recommended for exposed locations.



Figure 13 : 60mm finished face, 40mm deep, trapezoidal profiled boards with 10mm gaps.



Figure 14 : 100mm finished face, 19mm deep, trapezoidal profiled boards with 15mm gaps.

Shingles

The main timber used for shingles in Scotland over the last century has been Canadian cedar and, stained a dark brown or black with preservative, is seen quite frequently on 'forestry houses' throughout the country as well as on a type of timber-framed bungalow. However, there has been a revival of interest in making shingles from home-grown oak and larch and the Douglas Pavilion by Gaia Architects is one recent example.



Figure 15 : Larch shingles on all four elevations of a four story office in Vorarlberg, Austria.



Figure 16 : Larch shingles on parts of two elevations of house in Midlothian by Icosis.

Appendix F

The timber resurgence in Scotland (and beyond)

Case studies

Appendix F - The timber resurgence in Scotland (and beyond)

Timber use in construction is increasing throughout Scotland and the Government is taking a wide variety of initiatives to build on this.

It is possible to discern a definite increase of the use of timber in many regions of the world which may be identified as beginning in the late 20th century. This can be seen in countries with an unbroken history of timber skills such as Norway and Japan as well as in countries with more or less 'interrupted' timber building traditions such as Finland and the UK. Within this trend, Scotland can be seen to be experiencing its own resurgence, arguably more advanced than anywhere else in the UK. This is manifested in at least three ways; firstly in the increase in the use of a wide range of engineered timber products; secondly in the supremacy of timber frame structures in the domestic sector; thirdly and (more visually apparent) in an increase in the use of timber as an external cladding material.

Even the briefest survey of contemporary buildings in Scotland underlines a new interest amongst client groups and designers in timber supported by new attitudes to timber design in Local Authorities. Scottish Borders Council encourages this trend as part of sustainable development that can contribute to environmental and economic goals at the same time as protecting and enhancing the building traditions of the region.

The publication "New Timber Architecture in Scotland" by Peter Wilson is available free on request from FCS and provides nearly 100 examples of contemporary timber buildings in Scotland spanning all use types.

This appendix provides illustrated project sheets of buildings in Scottish Borders utilising timber either extensively or in specialist applications and includes a few examples from elsewhere in Scotland to illustrate specific uses of home-grown timber.

TIMBER FOR CLADDING: general notes to the case studies

This section intends to provide some design guidance for timber cladding predominantly with reference to case studies in the Borders Region but some from elsewhere in Scotland. Whereas parts 4.1 - 4.4 have dealt with technical aspects of cladding design, this section focuses on the aesthetic issues of timber cladding.

General approach

As in other parts of Scotland, timber cladding will almost certainly have been a part of the Scottish Borders vernacular in historical times. Unfortunately, very few of these examples still exist from the last one hundred years in the region and it is therefore not particularly helpful to refer to a vernacular in this context. Quite apart from this, worldwide contemporary use of timber cladding and advances in treatments, coatings and changes in timber species availability all contrive to require a fresh and thoroughly modern approach to design for this material.

It is instructive, therefore, to look at timber cladding on buildings designed and built in recent times in a variety of rural and urban sites in Scotland as well as in broadly similar climates abroad. These examples span sensitive additions to existing natural stone buildings at one extreme to modern interventions in contemporary townscapes at the other. Nearly one hundred examples of timber clad buildings of all different types and scales are presented in "New Timber Architecture in Scotland" (Peter Wilson, FCS) which is an excellent source book for inspiration.

The built environment of Scottish Borders is varied, ranging from isolated rural settlements to small villages and medium sized towns. Timber cladding solutions appropriate for one setting may not be suited to another and it should be the aim of designers to respond sensitively to individual circumstances. To underline this very project-specific and detailed approach to cladding design, this Guidance presents case studies according to six site and building function types which cover the majority of types likely to be encountered. All the buildings shown are considered to display a good to high standard of cladding design.

A recurring theme in any discussion of timber cladding in Scotland is the question of whether to paint or to leave timber untreated. Opinions often divide quite strongly on this issue and it is largely a matter of personal taste. From the forgoing technical advice and the illustrated case studies, it is clear that the design of untreated timber façades requires care to control any aesthetically undesirable differential weathering. It is equally clear that painting and staining leads into ongoing maintenance cycles as well as careful judgement of colour schemes.

It is possible that less durable timber as well as modified timber will both be increasingly utilised for cladding in the future and both will necessarily be surface coated more as in the Scandinavian tradition. This will raise issues about appropriate colour in the Scottish environment which has traditionally utilised very muted colours. In many cases these will be the safer choice but reference to Scandinavian buildings may suggest some tried and tested colour possibilities.

Isolated rural domestic houses

In some respects this may be the most straightforward environment in which to design timber-clad buildings as there is clear historical precedent throughout the entire country. Indeed nearly all Local Authorities have embraced the idea of isolated timber-clad buildings, even in un-wooded environments.

Main considerations of a technical nature often involve local micro-climate and exposure in particular. It is particularly appropriate in this type of environment to consider any locally available timber as a cladding material. It is especially rewarding and appropriate to clad a rural building with timber taken either from or nearby the site and, as can be seen in some of the case studies in this section, a wide variety of species can be used if detailed and treated correctly.

Timber clad additions to existing natural stone and harled houses

It can be challenging to successfully blend a contemporary addition using timber cladding to an existing natural stone building and the relationships of scale and form of new to old will be paramount. The timber cladding of the new addition will, however, provide a deliberate and clear differentiation between old and new and the most appropriate strategy may be to ensure that the new does not overpower the old. Ideally it will play its subservient role with a modesty that does not have to deny modernity. Any timber features such as porches or bargeboards on the existing buildings may act as a point of departure for new timber details on the addition. Colours of any painted wood may also give cues.

New build housing development

The use of timber cladding as wall finishings of suburban and urban housing developments in Scotland has increased over recent years. However the majority of it can at best be described as tokenism in regard to any environmental agenda and, in many instances, has also done little or nothing to improve the overall aesthetic of designs. However, there are the beginnings of more significant use of timber in such housing schemes and the development of a more sophisticated sensibility to the way timber and masonry finishes can be combined. There appears to be a reluctance to develop this to the point where timber cladding is used wholeheartedly, due perhaps to issues of vandalism and maintenance. However, new timber treatments and subtle combinations of timber with other materials are now addressing these issues successfully.

Visitor centres and public buildings

Visitor centres, large and small have been a particularly fertile area in recent years for designers in Scotland wishing to use timber in both structure and cladding and several fine examples have been built. Furthermore, there has been a particular interest in the use of home-grown material, often driven by the clients' own environmental remits and ambitions. It is to be hoped that many others will take their cue from these buildings in the years to come and that Scottish Borders will produce examples of its own using home-grown timber.

There is scope for more use of timber in many types of public building and it is as appropriate within the urban fabric as it is in the countryside. Examples in 'New Timber Architecture in Scotland' illustrate that, from arts centres to multi-storey car-parks, timber cladding can be a functional and aesthetically pleasing choice.

Retail buildings

Timber cladding is now being used even on large scale buildings designed to demanding environmental briefs and will help such projects achieve good carbon profiles. As scale increases, maintenance of any external cladding becomes a more important issue and the choice of material and its treatment will reflect this priority.

Flats

The softer aesthetic of timber structure and cladding can make a particularly good choice for multi-storey residential developments. Quite frequently, building regulations in relation to fire spread will prohibit entirely timber façades but combinations of timber and masonry can often be achieved.

Appendix F

The timber resurgence in Scotland (and beyond)

Case studies

ISOLATED RURAL DOMESTIC HOUSES

GRANGEWOOD, near Coldingham

A house designed and built by Quercus Rural Building Design

SCOTTISH LARCH ; UNTREATED ; OFF SAW VERTICAL BOARD ON BOARD

The cladding design is entirely consistent with the setting and design approach of the building as a whole which was to provide a genuinely exemplary, low carbon design. The cladding is therefore locally sourced larch, straight off-saw and used in simple board on board vertical pattern for maximum economy of means. It is also left untreated to weather naturally, keeping all materials to a minimum and relying on the natural durability of the material. Although the simplest of cladding types, the detailing is good, the cladding is well clear of the ground as the building is on piers and the generously thick 140 x 22 mm boards are secured with stainless steel nails.

The joint contexts of this building are its exceptionally high environmental brief (it is off mains and powered by its own windmill in combination with photovoltaics) as much as its wooded rural setting. The cladding solution is a consistent and persuasive response to both these contexts that refers to simple agricultural precedents. The house is indeed a farm house and part of a collection of farm buildings. The use of profiled steel on the roof brings a further consistency with its reference to agricultural buildings.



ISOLATED RURAL DOMESTIC HOUSES

OLD PARR HOUSE, Minto A house designed by Will Grime Architect

SIBERIAN LARCH ; UNTREATED ; DRESSED & PROFILED VERTICAL

The cladding design presents a sophisticated, flush-faced and dressed finish which feels consistent with the overall sophistication, yet restrained palette of other exterior materials. The strong linearity of the stainless steel standing seam roof is echoed in the unbroken vertical cladding. The whole exterior displays a refined and simple dignity in keeping with the historical landscaped grounds.



The cladding is fully profiled and dressed Siberian larch boards with a face width of 150mm and a depth of 22mm, all stainless steel nailed. While window sills are in aluminium, drips and flashings are in stainless steel providing maintenance free details. The cladding is being left untreated to weather naturally. Generous eaves of around 700mm all round will help to protect it.

ISOLATED RURAL DOMESTIC HOUSES

INCHDRYNE LODGE, near Nethy Bridge, Highland
A house designed by North Woods and Locate Architects

SCOTTISH LARCH ; PAINTED ; HORIZONTAL, DRESSED & PROFILED ;

Unlike the two examples from Borders above, this house in the Highlands deploys a carefully considered colour scheme that embraces roof, window and door frames, exterior exposed timber elements as well as cladding. Each is given its distinct colour with the blue green stain of the cladding referring to the foliage of the surrounding Scots pine forest ; the reddish brown of the exposed posts and beams closely echoing their trunks and branches.



The cladding is Highland grown larch in keeping with the strong environmental brief for the design which was to use only Scottish timber throughout the building. It is fully profiled and dressed and laid horizontally throughout. The strongly expressed cladding dividers and trim are in aluminium. Despite the relative brightness of materials, the sophistication of the palette combined with the broken forms of the building and the proximity of the trees give it the feeling that it has somehow always been there.

ISOLATED RURAL DOMESTIC HOUSES

HOPE, Pathhead, Midlothian
A house designed by Icosis

SCOTTISH LARCH ; OFF-SAW 'SLEEPER' CLADDING ; SCOTTISH LARCH SHINGLES

This highly contemporary rural house makes use of three different cladding types on its timber frame : render, timber shingles and horizontal timber boards. Both shingles and boards are of home-grown larch and neither are treated in any way. The boards are 250 x 40mm "sleepers" and are fixed to battens from behind so that no fixings are visible on their faces. All the sleepers are of the same length and mounted to leave clear gaps of 10mm horizontally and about 5mm at their ends. There are no reveal boards relying instead on sealing of the membrane to the window frame for weather-proofing. Sills are powder coated aluminium.



The strong differentiation of cladding types is skilfully brought together by the architect as each type emphasises a different elevation or component of the construction. The open cladding type is only on the sheltered north elevation and the use of render on the south removes timber from the most exposed elevation in this case. The south elevation is composed of many different shaped surfaces and is heavily punctuated by windows as well as a balustrade. The plain white render helps to unify the south elevation but the use of timber on the other elevations helps to soften the overall mass of this relatively large rectilinear shape in the landscape.

ISOLATED RURAL DOMESTIC HOUSES

ROBINSON HOUSE, Glen Urquhart, Highland A house designed by Neil Sutherland Architects

SCOTTISH & RUSSIAN LARCH ; UNTREATED ; VERTICAL & HORIZONTAL

This house responds to its deeply rural native woodland setting with a combination of rough sawn timber, turf roof and extensive decking. The use of a natural stone base course in part of the building further roots the building into its environment. This stonework is an un-mortared facade capped with a Caithness slab sill. This low budget building utilizes a simple rectilinear plan and simple but effective details including high quality factory painted windows and steel raingear.



The cladding is mostly locally sourced larch in a simple board on board vertical arrangement. All boards are 150 x 20mm and left untreated. There is a strongly expressed break in the vertical boards at first floor platform level where the upper boards step out above a galvanized steel drip. The porch area is of slightly contrasting horizontally laid Siberian larch cladding, also left to weather naturally. Large roof overhangs are a characteristic of this designer's buildings and help to protect timber from the Highland weather.

TIMBER-CLAD ADDITION TO EXISTING MASONRY BUILDING

EXTENSION TO PRIVATE HOUSE, Heriot
Designed by Jenny & Chris Humphreys Architects

SIBERIAN LARCH ; UNTREATED ; SHIPLAP

It could be argued that the success of this extension to a traditional stone-built group of buildings relies largely on its form and scale, on the subtle relationship of roof pitches, old to new and other proportions. The relatively tall, vertical emphasis of the fenestration and the matching of frame colours are other important ingredients.

Furthermore, the offset, glazed entrance provides a critical degree of separation between original and new which accords with much planning guidance from around the country and with contemporary architectural thinking on this subject of contemporary extensions to old buildings of note.



The timber cladding - Siberian larch shiplap with face width of 100mm - is a bold statement and its design and detailing is also a part of the success of the overall composition. The horizontal cladding pattern reduces the overall feeling of the mass of the extension and its clear and simple detailing complements that of the stone houses. The untreated and stainless steel nailed timber cladding will weather to grey which will tend to further downplay the extension in relation to the original. However the weather exposed and visually significant bargeboards are painted and will help to maintain a coherent colour scheme and maintained appearance.

TIMBER-CLAD HOUSE CLOSE TO EXISTING MASONRY BUILDINGS

GARDEN HOUSE, Near Duns, Scottish Borders A house designed by Icosis

SCOTTISH LARCH ; UNTREATED ; SHIPLAP

Sited between a traditional stone cottage and a farm-yard, the modest scale and simple lines of this timber house fit well with their surroundings. The concept of a dominant rectangular plan with garage and a 'lean-to' (in this case a sunroom) as additional elements is common in rural situations. In this case these additions, set well back from the front gable have neat flat roofs helping to reduce the mass and leaving the simple south facing gable clearly expressed.



The cladding is untreated home-grown larch fixed with stainless steel nails in shiplap configuration. Corner details are also in larch but window sills are painted aluminium. The cladding is carefully laid out in short horizontal bands that tie in with windows. This may help to disguise the differential staining that often occurs under protruding trim on untreated cladding. There is a clear 8mm gap between the ends of boards in adjacent bands and the cladding is well clear of the ground with the building on a brick plinth. All detailing elements are thus thought out to improve durability and appearance as the cladding naturally weathers.

TIMBER HOUSE CLOSE TO EXISTING MASONRY BUILDINGS

Paterson House, Tranent, East Lothian
A house designed by Paterson Associates

CEDAR ; UNTREATED ; VERTICAL BOARD ON BOARD

A highly efficient design in terms of spatial planning, energy and material use matched by a contemporary simplicity in elevation. Resembling more the type of modern energy efficient timber buildings seen in central Europe, this may be the shape of buildings to come. In this context this is a useful early example of a quite radically different building form situated in close proximity to traditional forms. More typical evaluations of whether it “matches” or “blends in with” its neighbours are challenged and one is perhaps asked to view the building (a) as a sculptural form in its own right and (b) in the context of environmental performance rather than conditioned expectations of shape and materials. It may be instructive to imagine a whole group of such houses together in different configurations and colours in making a wider assessment of suitability to the Borders or Scottish environment.



The cladding is untreated western red cedar from Canada in vertical board on board profile. The boards are very carefully installed with no horizontal breaks except for openings. The windows further accentuate the verticality of the elevations while the concrete plinth provides a satisfyingly distinct transition with the ground as well as elevating the timber above the splash zone. Details are all very precisely handled, essential to such a boldly simple design.

ADDITION TO EXISTING MASONRY BUILDING

EXTENSION TO PRIVATE HOUSE, Midlem Designed by William Grime Architect

SIBERIAN LARCH ; UNTREATED ; VERTICAL BOARD ON BOARD

Standing amongst traditional masonry and harled cottages around a village green, this extension was not without its opponents. The existing cottages have long axes aligned parallel to the road but with garages at right angles and the timber extension was designed to continue that rhythm.

It s also utilizes a recessed link section with entrance door on the main public elevation which helps to differentiate old from new. It is that balance of differentiation and continuity that is the essence of good extension design. In this case the slate on the roof provides some continuity along with roof pitch and general simplicity of rectangular plan and form.



However the timber cladding does stand in marked contrast to the harled original walls and the vertical board on board cladding gives a particularly pronounced surface texture which was not the architect's original intention. The Siberian larch cladding is being left to weather naturally which will help to make the extension 'recede' but it is interesting to reflect on whether a more flush cladding pattern, or a horizontal one or even a painted one in this particular situation might not have been more successful.

ADDITION TO EXISTING MASONRY BUILDING

EXTENSION TO STEADING, Morebattle Designed by William Grime Architect

SIBERIAN LARCH ; UNTREATED ; SHIPLAP

A winner of the Scottish Borders Council design Awards in its category, this timber extension to an isolated rural stone built steading was viewed as exemplary in both its fusion of old and new and in its environmental brief.

Siberian larch shiplap cladding has been left to weather naturally and is complemented by a larch board on board roof. Some details including window sills are in stainless steel enlivening the otherwise very subtle, recessive tones and traditional forms.



As is often the case, the extensive use of timber in this agricultural environment seems perfectly natural and there is a ready harmony with the equally natural appearance of local field stone walling. It was perhaps only a shame that the locally available larch which was also considered for the project was felt to be too poor a quality to achieve the desired result.

ADDITION TO EXISTING MASONRY BUILDING

EXTENSION TO GRADE B LISTED MANSION, Linn Park, Glasgow Designed by JM Architects

SCOTTISH LARCH ; PAINTED ; VERTICAL BOARD ON BOARD

This highly contemporary, flat-roofed timber extension to a “classical” (1820) listed stone building is included here for its apparent contrast to the case studies chosen from the Borders in this category. It may at first appear to represent a quite different approach to the same essential challenge of extending and giving a new lease of life to a fine stone building. But aspects of its design do follow similar principals to those given in the above case studies.

Its' home-grown, European larch, vertical board on board cladding has only a narrow front face gap giving a relatively flush surface which, combined with the utter simplicity of detailing and the uniform black stain, confer both a remarkable dignity and architectural coherence of form on the addition.

It certainly maintains a sense of strong differentiation of old and new but, despite its unapologetic individuality, it still manages not to detract from the original when viewed from the main public elevations.



SOCIAL HOUSING

Todlaw supported housing with shared services facility, Duns
Designed by Oliver Chapman Architects for Berwickshire Housing Association

SIBERIAN LARCH ; DRESSED & STAINED ; VERTICAL BOARD ON BOARD

Working within both the simplest rectangular floor-plans and traditional 45 degree symmetrically pitched roof forms, this collection of buildings provides a remarkably rich and satisfying visual experience. A large part of this is conferred by the high degree of consideration given to both the textures and colours of the wall surfaces which comprise both board on board timber and fibre cement tiles.

The vertical cladding is all of 120x 19mm dressed Siberian larch giving a pronounced surface texture with the front boards about 75mm apart. In some houses the timber cladding is on the side elevations only whilst others have a timber clad gable combined with a tiled long elevation. Four different coloured stains are used : a blue/green, very pale grey/blue, pale mushroom and a darker brown. These combine with grey window frames, black painted timber structures and the dark grey of the tiling in a striking yet subtle composition.



Cladding details are very concise with clearly defined sills and top drips accentuating the strong linearity of the design. The elevations are kept clearer by the recessed raingear. The aggregated, as opposed to scattered, nature of the fenestration gives some particularly pleasing expanses of uninterrupted cladding which contrast well with the busier areas of the covered walkway and entrances.

SOCIAL HOUSING

SOCIAL HOUSING SCHEME, Tweedbank Designed by Bain Swan Architects for Eildon Housing Association

ACCOYA ; PAINTED TWO COLOURS ; VERTICAL & HORIZONTAL PROFILES

The elevations of this housing scheme combine brick with painted Accoya cladding (see Part 4.3). Some of this cladding is in vertical and some in horizontal pattern, the contrast of which is accentuated by the use of two colours, grey and off white. This factory applied opaque coating will further enhance the already long service life of this cladding.



While the style and “boot polish” finish of the front doors harks back to some bygone age, the overall effect of the painted cladding gives a decidedly upbeat, smart and cheerful aesthetic to this development. It could be argued that the base brick course on the long elevations is somewhat fussy but the client insisted on this to minimize possible damage to timber in a more vulnerable area. Other brickwork on gables etc is to meet Building Regulations with respect to fire spread.

FLATS - AUSTRIA

Austria is considered by many to be a centre of excellence in timber design and it may be instructive therefore to look at some examples. It should be remembered that the climate is more continental than the Scottish one. That is to say, it has less rainfall, more sunshine but much colder and snowier winters. The tradition has therefore been for quite big roof overhangs but the examples here show that contemporary design has not always kept that tradition.

Austrians have generally preferred to leave their timber unpainted as they have a resource of home-grown larch for exterior cladding. This tradition is still definitely in favour especially in the Province of Vorarlberg where these three examples are located.



The effects of differential weathering on the cladding are very clear in these examples. The top one is new and is yet to show any greying. The second one illustrates how even a small step out in the cladding creates a protected zone and an area of less weathered timber. This is an example however where the effect appears very much part of the design intention.



In the third example weathering is well advanced and it will not be long before the façade is of an even grey. With virtually no breaks, drips or sills, the effect will be very even.



The bottom example shows open cladding using a narrow faced board. Each piece of cladding is trapezoidal with 45 degree slope top and bottom. Boards are 35mm deep. Notice how the fixings become a definite feature and underline the need for great attention to accuracy in installation.



FLATS - SCOTLAND

This two storey block of flats is in Glasgow, designed by Elder & Cannon, and illustrates increasing acceptance of timber cladding even in inner city areas.



Vertical board on board untreated western red cedar with a horizontal band breaking the vertical lines at first floor platform level.



Designed by Gareth Hoskins for Cloch Housing Association

Horizontal larch cladding in discreet panels broken by a steel structural frame.



Appendix G

Sources of further advice

Appendix G - Sources of further advice

Publications

Scottish Borders Council

Scottish Borders Structure Plan

<http://www.scotborders.gov.uk/life/planningandbuilding/plansandresearch/2747.html>

Scottish Borders Local Plan

<http://www.scotborders.gov.uk/life/planningandbuilding/plansandresearch/2748.html>

Scottish Borders Woodland Strategy

<http://www.scotborders.gov.uk/life/planningandbuilding/plansandresearch/5660.html>

Scottish Government

“Timber Cladding in Scotland”

<http://www.scotland.gov.uk/Resource/Doc/46910/0024271.pdf>

This publication covers the principles of treatment of all applications of timber (not just cladding) and refers to the authoritative British and European Standards. It is essential reading for those designing and building in timber in Scotland.

“Designing the timber façade” (in preparation)

A Policy on Architecture for Scotland.

<http://www.scotland.gov.uk/Resource/Doc/158271/0042853.pdf>

Scottish Climate Change Programme (SCCP)

<http://www.scotland.gov.uk/Publications/2006/03/30091039/0>

The SCCP is an excellent source of facts and figures on all aspects of CO2 management as it relates across all sectors of the Scottish economy. It also helps to give a general understanding of the mechanisms of climate change and the ways it may affect us in the future.

Forestry Commission Scotland (with others)

The Scottish Forestry Strategy (SFS)

<http://www.forestry.gov.uk/sfs>

FCS ‘Timber Development Programme’

[http://www.forestry.gov.uk/pdf/fcfc113.pdf/\\$FILE/fcfc113.pdf](http://www.forestry.gov.uk/pdf/fcfc113.pdf/$FILE/fcfc113.pdf)

ECCM – Forestry Commission Scotland, Green House Gas Emissions Comparison – Carbon benefits of timber in construction, 2006

[http://www.forestry.gov.uk/pdf/Carbonbenefitsoftimberinconstruction.pdf/\\$FILE/Carbonbenefitsoftimberinconstruction.pdf](http://www.forestry.gov.uk/pdf/Carbonbenefitsoftimberinconstruction.pdf/$FILE/Carbonbenefitsoftimberinconstruction.pdf)

“Sustainable Construction Timber”

Centre for Timber Engineering and Forestry Commission Scotland (FCS) for The Scottish Government, 2009

<http://www.forestry.gov.uk/forestry/infd-6b2jfb>

Others

Kyoto agreement

<http://unfccc.int/resource/docs/convkp/kpeng.pdf>

BSI British Standards are currently in the final stages of releasing a new standard PAS 2050 - Assessing the life cycle greenhouse gas emissions of goods and services

<http://www.bsi-global.com/en/Standards-and-Publications/How-we-can-help-you/Professional-Standards-Service/PAS-2050/>

‘Using NIR Spectroscopy to measure the durability of larch’, Centre for Timber Engineering, March 2009

‘UK database of embodied energy’

The most comprehensive and up to date embodied energy database of building materials (around 170) is known as the Inventory of Carbon and Energy (ICE) and is available for download as a PDF file from the Dept of Mechanical Engineering (University of Bath)

<http://people.bath.ac.uk/cj219/>

‘Green Oak in Construction’, TRADA

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

European Standard BS EN 350-2:1994, Durability of wood and wood-based products,

Guide to the principles of testing and classification of natural durability of wood.

European Standard BS EN 460:1994, Durability of wood and wood-based products,

Guide to the durability requirements for wood to be used in hazard classes 1-5.

Organisations

Scottish Forest Industries Cluster (SFIC)

<http://www.forestryscotland.com/>

Centre for Timber Engineering (CTE)

<http://www.cte.napier.ac.uk/>

Vorarlberg Tourist Board

<http://www.vorarlberg.travel/xxl/area/38273/subArea/382768/subArea2/385130/lang/en/index.html>

Argyll Green Woodworkers Association

<http://www.argyllwood.co.uk/AGWA/agwahome.htm>

Central Point of Expertise on Timber (CPET).

<http://www.proforest.net/cpet>

Other information

<http://www.illegal-logging.info>

<http://www.firstnations.eu>

Scottish Borders Woodland Partnership member organisations:

