The new Welsh Assembly Government building in Aberystwyth: Opportunities for meeting the sustainability agenda

Prepared for: User and Procurement group of the Welsh Assembly building in Aberystwyth

31 March 2005

Report number 222-338
EXECUTIVE SUMMARY

Sue Essex, Minister for Finance, Local Government and Public Services announced on 23 February the move of the Welsh Assembly to new offices in Aberystwyth and Llandudno Junction. Within the next three years a total of 1,025 jobs will be located in the new offices of Welsh Assembly Government.

The construction of new offices for the Welsh Assembly Government, including the Forestry commission for Wales, brings a challenge to designers, procurement and clients alike. As a building constructed at public expense, there is a clear need to demonstrate that current best practice is followed and value for money is obtained. Timber is an important resource in Wales and the new Welsh Assembly offices should reflect this importance by using timber based building elements and components as much as possible. This gives the timber industry an opportunity to demonstrate what can be achieved using the Welsh resource, boosting the local economy.

The document aims to provide a basis for discussion between all stakeholders involved in the process, identifying the possible uses of the versatile Welsh timber resource and highlighting some of the procedures needed to enable the use of Welsh timber in the Welsh Assembly building.

The report is subdivided into three main sections:

- Functional requirements for a building such as the Welsh Assembly
- The Welsh timber resource
- Timber businesses and enterprises in Wales

This document draws together all the aspects of timber usage that can be envisaged in the construction of a new building designed to accommodate the members of the Welsh Assembly Government and the Forestry Commission for Wales and others.
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BACKGROUND</strong></td>
<td>4</td>
</tr>
<tr>
<td><strong>INTRODUCTION</strong></td>
<td>5</td>
</tr>
<tr>
<td><strong>SCOPE OF FUNCTIONAL REQUIREMENTS</strong></td>
<td>8</td>
</tr>
<tr>
<td>General requirements of materials and products</td>
<td>8</td>
</tr>
<tr>
<td>Environmental impacts of materials</td>
<td>9</td>
</tr>
<tr>
<td>Energy and ventilation</td>
<td>12</td>
</tr>
<tr>
<td>Disability Discrimination Act (DDA) 1995</td>
<td>Error! Bookmark not defined.</td>
</tr>
<tr>
<td>Features and elements of the building</td>
<td>Error! Bookmark not defined.</td>
</tr>
<tr>
<td><strong>THE WELSH TIMBER RESOURCE</strong></td>
<td>47</td>
</tr>
<tr>
<td>Standing tree coverage by species</td>
<td>48</td>
</tr>
<tr>
<td>The supply chain and associated activities</td>
<td>50</td>
</tr>
<tr>
<td>Brief description of major species</td>
<td>51</td>
</tr>
<tr>
<td>Timber acidity</td>
<td>62</td>
</tr>
<tr>
<td>Moisture content and the timber resource</td>
<td>62</td>
</tr>
<tr>
<td>Durability</td>
<td>63</td>
</tr>
<tr>
<td>Structural timber</td>
<td>65</td>
</tr>
<tr>
<td>Truss rafter roofs</td>
<td>66</td>
</tr>
<tr>
<td>Welsh structural timber</td>
<td>66</td>
</tr>
<tr>
<td>Glulam</td>
<td>66</td>
</tr>
<tr>
<td>Wood based panel products</td>
<td>68</td>
</tr>
<tr>
<td>Non-structural timber- ‘Green’ Gluing</td>
<td>68</td>
</tr>
<tr>
<td><strong>OVERVIEW TIMBER RELATED BUSINESSES IN WALES</strong></td>
<td>73</td>
</tr>
<tr>
<td>Roundwood</td>
<td>73</td>
</tr>
<tr>
<td>Sawn timber</td>
<td>74</td>
</tr>
<tr>
<td>Structural timber</td>
<td>76</td>
</tr>
<tr>
<td>Packaging and storage</td>
<td>77</td>
</tr>
<tr>
<td>Outdoor features</td>
<td>78</td>
</tr>
<tr>
<td>Homebuilding and renovating</td>
<td>79</td>
</tr>
<tr>
<td>Joinery and furniture</td>
<td>80</td>
</tr>
<tr>
<td><strong>CONCLUSION AND RECOMMENDATIONS</strong></td>
<td>81</td>
</tr>
<tr>
<td>Appendix A – CONTACTS at BRE</td>
<td></td>
</tr>
</tbody>
</table>
BACKGROUND

The construction of new Welsh Assembly Government offices in Aberystwyth and Llandudno Junction was announced by Sue Essex AM, the Minister for Finance, Local Government and Public Services, on 23 February 2005. Over the next three years a total of 1,025 Welsh Assembly staff will be accommodated in the new buildings.

The Llandudno Junction office will house around 525 posts, including 130 relocated from Cardiff, while the Aberystwyth office will have around 500 posts, including 179 from Cardiff. Both offices will house a generic element that will serve as a 'first stop shop' for the public.

'The relocation of a mixture of executive and policy functions on this scale will provide a major boost for the local economies of mid and north Wales,' said Sue Essex. 'The new offices will give the Assembly Government a significant presence in mid and north Wales. It is a significant step in our plan to spread the benefits of Assembly employment more evenly throughout Wales and to bring the formulation and delivery of Assembly Government policy and services closer to the people we serve.'

Constructing the new buildings, (which will include offices for the Forestry commission for Wales) presents opportunities and challenges to all those involved in the commissioning, design and procurement processes. With such projects undertaken at public expense there is, of course, a particular need to demonstrably employ current best construction practices, implementing sustainability targets and obtaining value for money.

It will be necessary for the buildings to meet wide ranging expectations of many interested parties. For example they will need to reflect a strong national identity, with Welsh cultural traditions clearly represented. There will be demands for the highest possible environmental credentials, and the buildings will have to be models of affordable and effective sustainable development. Timber can successfully meet these requirements using Welsh materials, industry and skills.

There is a strong case for reflecting importance to Wales of its timber resources in the construction of the new Welsh Assembly offices, by using timber based building elements and components as much as possible. This will provide an opportunity to demonstrate what can be achieved using Welsh timber, while boosting local economies.

This report aims to provide a basis for discussion between all stakeholders involved in the process, identifying the applications and versatility of Welsh timber, and highlighting some of the procedures that will enable its extensive use in the Welsh Assembly building.
INTRODUCTION

BRE’s Centre for Timber Technology and Construction (CTTC), in collaboration with other BRE centres of expertise, has mapped out the opportunities for using Welsh timber based products and building elements in constructing the planned new Welsh Assembly Government buildings.

This report provides the basis for discussions between all those involved in the design and construction of the new buildings, identifying the uses of Welsh timber and highlighting the necessary procedures. In some instances the use of Welsh timber may require a customised approach and this is explained in detail.

The recommendations given in this report are based on requirements and guidance for office spaces provided by the British Council for Offices (BCO).

In preparing this report it has been assumed that a government building of the size and functions proposed is likely to require the rooms and facilities listed below.

<table>
<thead>
<tr>
<th>Public and semi-public areas such as</th>
<th>Workplace areas such as</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reception</td>
<td>Office workstations</td>
</tr>
<tr>
<td>Exhibition space</td>
<td>Meeting rooms- open plan and enclosed</td>
</tr>
<tr>
<td>Board and lecture rooms</td>
<td>Restrooms</td>
</tr>
<tr>
<td>Common rooms, lunch areas</td>
<td>Storage</td>
</tr>
<tr>
<td>Restrooms</td>
<td>Photo copy rooms</td>
</tr>
<tr>
<td>Secure server room</td>
<td>Tea rooms</td>
</tr>
<tr>
<td>First aid room</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>External ancillary areas such as</th>
<th>Outside areas requiring</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT storage</td>
<td>Landscaping</td>
</tr>
<tr>
<td>Showers, changing rooms</td>
<td>Car parking and access</td>
</tr>
<tr>
<td>Equipment store</td>
<td>Signage</td>
</tr>
<tr>
<td>Fitness room</td>
<td>Recreational areas</td>
</tr>
<tr>
<td>Children Nursery</td>
<td></td>
</tr>
</tbody>
</table>
The building, its composition, structure, finishes and facilities will have to:

- provide an appropriate safe and secure physical environment for all users and employees
- make efficient use of space, buildings and land
- provide an environment that is designed to improve the productivity of the users and lead to an increase in use and involvement by the community, clients and staff.
- be energy efficient, environmentally friendly, sustainable and demonstrate best practice and best value.

It is essential to ensure that building design and procurement advice is sought at the concept stage. At the start of the procurement process advice on specific issues should be considered. This approach has been shown to achieve better quality buildings, demonstrating best value and practice.
SCOPE OF FUNCTIONAL REQUIREMENTS

The materials and products selected for the construction of the Welsh Assembly buildings in Aberystwyth must provide the designers with the tools to successfully achieving the buildings’ wide range of functional requirements. This section of the report presents an overview of the means of meeting these requirements using timber and timber based products in combination with other materials, giving special consideration to the local Welsh resource.

It considers:

- the general requirements of the materials and products
- energy, environment and ventilation
- the Disability Discrimination Act 1995
- the individual elements and features of the building

General requirement of materials and products

Material selection should always be based on issues relating to embodied energy and environmental impact. The new Welsh Assembly Government in Aberystwyth provides an outstanding opportunity for Wales to demonstrate its commitment to sustainable development. For this the development team will need to embrace the key principles of:

- considering sustainability issues right from the start and throughout the design and commissioning process.
- working in an integrated way across the team disciplines to provide a sustainable building.
- making design decisions based on the balance between whole life cost and environmental impact.

The Welsh Assembly buildings in Aberystwyth should use materials and products which

- are recycled, reclaimed or new
- are suitable for the services and conditions of use normally expected to apply after the installation is complete
- are able to withstand the testing and commissioning conditions specified
- do not contain ozone-depleting materials except where there is no alternative
- comply with EC Directive 2037/2000 on the use of ozone depleting substances
- are, in the case of fire and security products shall be listed in Loss Prevention Certification Board List of Approved Fire and Security Products and Services book
- do not initiate mould growth, support vermin, contain crocidolite or support bacterial life
• do not involve the use of CFC’s at any stage of manufacture, installation or subsequent operation
• are free from objectionable odours at the maximum or normal working conditions of operation
• do not suffer deterioration at the maximum or specified conditions of operation
• are capable of being applied to a base surface without causing damage or deterioration of the base
• do not evolve dense or toxic fumes when subjected to excessive heat
• are, when of similar type, made by the same manufacturer
• ensure products are whenever possible manufactured and/or stocked under one of the following
  • BSI Kitemark Scheme
  • BSI Safety Mark Scheme
  • BRE Certification quality tick mark
  • BRE Certified Environmental Profiles
  • Other, such as TRADA Q mark

These are addressing quality issues
  • from Firms of Assessed Capability to BS ISO 9000
  • from Stockists of Assessed Capability to BS ISO 9000

Environmental impacts of materials

Construction product manufacture, transport and erection are estimated to produce 10% of UK CO₂ emissions. If all new buildings reduced their impact (through choice of materials) by 10%, a saving of 6.6 million tonnes of CO₂ could be made.

Building design needs to consider the environmental impact of the materials used ‘from the cradle to the grave’ – that is, impacts resulting from their manufacture, during construction, when the building is in operation, and when they are finally disposed of or recycled. Life Cycle Assessment (LCA) is a methodology that enables the evaluation of environmental impacts of a system over its full life cycle. This is important because if only part of the life cycle is considered significant environmental impacts can be overlooked.

Life-cycle thinking demonstrates that not only the type of product used is important, but also how the product is produced (with clear links to environmental management systems) and, even more importantly, how it is used (and treated when its first life is over).

Materials should durable and obtained from suppliers with sound environmental policies and practices. Certified timber is generally agreed to be one of the best available options. However, if suitable certified timber is not available then preference should always be given to local suppliers.

It is desirable to avoid materials that damage the environment either through their exploitation (tropical hardwood from non-sustainable sources) or through their production (e.g. blown polyboard).
To encourage use of low impact – over the full life of the building – construction materials, it can be stipulated that developers should, as a minimum, specify A rated construction materials as described in generic form in the BRE *Green Guide to Specification* for the following key elements (BREEAM credit Mat 1-3)¹:

- External walls (e.g. treated weatherboarding, insulation, dense blockwork, plasterboard/plaster)
- Windows (e.g. hardwood timber framed window/curtain walling)
- Roof (e.g. for flat roof made of plasterboard, timber joists, plywood decking, vapour control layer, insulation, felt isolating layer, asphalt, chippings)
- Upper floor slabs (e.g. beam and blockwork floor with screed)

Please note that LCA has limitations, it does not

- cover all aspects of sustainable construction
- address economic or societal issues
- assess quality of the indoor environment and the impacts upon human health
- evaluate comfort and productivity
- stipulate sustainable forest certification issues

¹ Whilst materials and components can be considered to have a lifetime from cradle to grave, it is not possible to assign a life to a pile of bricks or tonne of insulation - they only have a true 'life' when considered in the context in which they are used, e.g. as a wall. As part of a wall, or any other type of building element, building materials and components do assume a life: they fulfil various functions for a set amount of time, they have maintenance requirements and have to be dismantled at the end of their role in the building.
Environmental credentials of timber

To encourage the specification of timber for structural and non-structural elements from responsible sources, one of the five recognised certification schemes listed above should be selected if possible. The use of local resources will always be favoured, and if certification is not in place, alternative means of ensuring that the procured timber comes from sustainably managed sources must be sought. This will be in accordance with the public procurement and Central Point of Expertise on Timber advice to procure legal and wherever possible sustainable timber in construction. Alternatively, reused or recycled timber can be used.

The use of innovative approaches should encouraged, and where unusual materials are not listed in the BRE Green Guide to Specification, the manufacturer’s information on environmental impacts should be submitted with the design, for example, a BRE Certified Environmental Profile or equivalent. The building must aim to meet for a BREEAM Excellent rating (in current, 2005, version of BREEAM for offices) at design as well as post construction stages.

In order to reduce the potential for long-term damage to the ozone layer through the accidental release of ozone depleting substances, the group should procure products that do not contain ozone depleting materials and have minimal global warming potential, except where there is no alternative. A statement should be provided on how transport impacts associated with the supply of materials will be minimised, bearing in mind that sustainable construction can include issues such as the well-being of regional development, as well as environmental impacts. Wherever possible products should be sourced locally, but BRE’s LCA scores, presented in Ecopoints, allow the impacts from transport to be compared to those from producing construction materials.

An example

A designer seeking to specify windows with low environmental impacts finds two windows offering the same high performance in use, have the same lifetime and maintenance requirements and cost similar amounts:

Manufacture:
Window 1 generates 480 Ecopoints per 20 tonnes, in manufacture and is produced 1000 km from the development’s location.

Window 2 generates 640 Ecopoints per 20 tonnes in manufacture, but is produced 200 km from the development’s location.

Transport:
1000km of HGV transport produced 9.7 Ecopoints. A full HGV can load 20 tonnes of this size of window frame, and the HGV does not make its return journey empty, so:

Transport for window 1 covers 1000 km, so produces 9.7 Ecopoints.
Transport for window 2 covers 200 km, so produces 1.9 Ecopoints.
Overall:
Thus the total Ecopoints for each window option are:

Window 1: 480 Ecopoints from manufacture + 9.7 Ecopoints from transport = 489.7 Ecopoints.

Window 2: 640 Ecopoints from manufacture + 1.9 Ecopoints from transport = 641.9 Ecopoints

This shows that window 1 will produce the least overall environmental impact, and trying to source windows locally does not, in this case, reduce impacts on the environment.

Energy and ventilation
BCO recommends that new development, whilst providing a healthy, comfortable and productive environment should also:

- ensure that the best available environmental technology is taken into account
- provide the required energy input as efficiently as possible through the use of Low Carbon Technologies and/or renewable energy sources.

The Welsh Assembly building will be completed after the Energy Performance of Buildings Directive (EPBD) required legislation comes into force on 4 January 2006. For buildings with a floor area of more than 1000 m², the EPBD requires that formal consideration be given to the following alternative systems for heating:

- combined heat and power (CHP) plant
- district or block heating or cooling
- heat pumps
- decentralised energy supply systems based upon renewable energy
- ventilation with natural driving forces where possible.

In the UK, the Energy Framework Document (Part E), agreed by Government Ministers in March 2004, set specific targets for the Government Estate to improve its energy efficiency and to minimise its emissions of greenhouse gases.
The current route, by which most government departments are seeking to meet these targets for renewable energy, is through the procurement of certified ‘green energy’. Using renewable sources of energy can bring real benefits such as:

- reducing electricity bills
- minimising fossil fuel consumption
- avoiding the Climate Change Levy (CCL)
- avoiding proof of renewables obligation certificates (ROCs) and carbon training.

The construction of the new Welsh Assembly buildings brings ample opportunities for minimising energy consumption and using renewable energy sources. One of the viable options would be fitting biofuel boiler system for space heating. This heating system could be fuelled by locally grown, carbon neutral woodchips.

To meet SDIG (Sustainable Development in Government) targets all new construction projects have to minimise energy in construction, especially the ‘in use’ energy consumption which will have to meet at least current best practice for the construction type. Authorities and departments must measure and report as part of the post-project reviews, performance of new projects against established energy consumption benchmarks.

Bioenergy is the oldest form of renewable energy, using biomass fuels such as trees or crops. Biomass fuel resources can be replaced relatively quickly without permanently depleting the Earth’s natural resources, unlike fossil fuels.

One of the most attractive features of bioenergy is its availability regardless of weather conditions, provided adequate fuel storage and supply infrastructure is in place. This makes it ideal for use with other, more intermittent forms of renewable energy. Bioenergy would, for example, work particularly well with solar thermal systems. The costs of bioenergy can vary significantly, mainly depending on the cost of the boiler and the availability of fuel.

<table>
<thead>
<tr>
<th>Timber frame structures generally warm up quickly, which makes them particularly suited to buildings that are used part-time.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Considerations to me made with biomass heating include:</td>
</tr>
<tr>
<td>- the amount of biomass needed to achieve necessary kWh output for heating building under all service conditions</td>
</tr>
<tr>
<td>- the source of supply, also addressing transport impacts</td>
</tr>
<tr>
<td>- quality of supply (MJ per tonne biomass)</td>
</tr>
<tr>
<td>- continuity of supply</td>
</tr>
</tbody>
</table>

Biomass wood

---

*greening government* sets out to incorporating environmental objectives in operational aspects of departmental performance (e.g. by reducing energy and water consumption and recycling waste). It also emphasises the inclusion of green principles in policy appraisal and development.
on-site storage needs
availability of technical support for system

There are a number of examples of commercial, as well as housing, developments using forms of biomass heat installations across the country, for example, Worcestershire County Hall (accommodating 1000 staff plus public meeting areas) uses a woodchip powered heating installation. The primary criteria for selection of biomass are the robustness of the management arrangements and the cost per tonne of CO2 saved over the first 10 years of operation. A variety of organisations and businesses install and operate a boiler plants as well as supply woodfuel from sustainably managed local sources (e.g. harvested roundwood from local estates, slabwood from local sawmills, or locally grown energy crops)

It is interesting to note that the development of a renewable-energy sector in Wales is a key target for the National Assembly (set out in the Assembly’s strategy for trees and woodlands). An initial search for suppliers within 50 miles of Aberystwyth gave encouraging results. Already, this cursory review reveals that in the 50 miles radius around Aberystwyth there are around 30 existing suppliers for biomass. However, at this stage it is not possible to indicate the supply conditions for a biomass utilisation in the new Welsh Assembly Government building in Aberystwyth as the type of heating system, fuel specification, capacity and other variables will significantly influence supply requirements. These issues should be addressed in collaboration with the design team. Nevertheless, considering the presented support for biomass in existing policies and policy instruments there seems to be sufficient expertise and knowledge and resource, to enable the use of biomass.

Wood biomass mainly comes from

- Forestry/Woodland residue and thinnings (round wood, branch wood and brash produced from commercial forestry and woodland management. Woodfuel material can be sourced during the thinning process or after harvesting, where as much as 30% of the felled plantation is currently left on the forest floor
- Energy crops: Dedicated energy crops include short rotation coppice of both willow and poplar varieties

Abridged procurement decision tree for assessing viability of biomass woofuel use in construction- to be used at the onset of a project in co-operation with the design/procurement team
Wood manufacturing residue, characterised as untreated wood by-products from manufacturing and industry, such as furniture factories, wood packaging and construction.

The Welsh National Assembly’s strategy for trees and woodland states that ‘the development of wood-fuel technologies can make an important contribution to the production of renewable energy in Wales. The strategy goes on to state, ‘the development of facilities to burn wood at appropriate locations where there are constant demands for heat, such as community facilities, hospitals, or industry, can provide both power and background heating. Such combined heat and power plants will contribute to targets of maximising energy efficiency in Wales.’ Additionally, the Forestry Commission Wales has launched a £7 million grant scheme to kick-start a wood based sustainable energy industry in Wales.

Disability Discrimination Act (DDA) 1995

The Disability Discrimination Act of 1995 has resulted in amendments to Approved Document M of the Building Regulations and has adjusted the focus of the many building design and construction professionals.

Disabled access can be readily incorporated into timber frame buildings – including multi-storey buildings – without particular difficulties (though some special consideration of the issue of differential movement between lift shafts and timber frame is required).

The Welsh Assembly buildings represent the Assembly to the public and must meet, and where possible exceed, Building Regulation requirements and guidance. The needs of employees and visitors to the buildings should be of paramount importance in their design. The public includes the young and old, tall and short, those with poor vision and/or hearing, people who have difficulty walking, wheelchair users, people with pushchairs or young children, people with learning difficulties, or difficulty with holding and grasping things, and many others. Both buildings will provide a 'first stop shop' service to the public, and so they must be accessible and attractive to as large a proportion of the population as possible.

While designers often concentrate on wheelchair users when designing buildings in accordance with the DDA, statistics show that the vast majority of registered disabled people are not wheelchair users. It is very important to also consider those with sight and hearing impairments.

The provision of lifts will have to be assessed on receipt of technical specifications and drawings. The proposed designs should be of sufficient dimensions to accommodate one or more wheelchairs at any one time and provide access to all levels of the building. In this context the evacuation procedures of building occupants with disabilities need to be considered specifically, proposing dedicated design solutions and concepts.

3 Press release, from Minister for Finance, Local Government and Public Services, Sue Essex on Wednesday, 23 February
Suspended timber floors can meet DDA requirements, and it has been demonstrated that timber design solutions can provide thresholds that make dwellings accessible to wheelchair users and people of reduced mobility, and minimise the risk of water entering the building. (Kelly, D., 2004)

The ‘timber solution’ to level access requirements has many benefits that fall into three main categories:

- environmentally friendly
- cost effective insulation option
- householder friendly.

For further information see Guidance document BRE Scotland, 2004

| Welsh timber of appropriate and grade and durability can be used in level access flooring without special consideration. |

![Level access flooring in Maggies Centre, Dundee (Courtesy of Timber Engineering Connections Ltd)](image)
Features and elements of the building

<table>
<thead>
<tr>
<th>Building features and elements</th>
<th>Use of Welsh resource wherever feasible</th>
</tr>
</thead>
<tbody>
<tr>
<td>The following building elements need to be addressed</td>
<td></td>
</tr>
<tr>
<td>• Structure</td>
<td></td>
</tr>
<tr>
<td>• Roofs, down pipes and guttering</td>
<td></td>
</tr>
<tr>
<td>• External walls</td>
<td></td>
</tr>
<tr>
<td>• Windows and roof lights</td>
<td></td>
</tr>
<tr>
<td>• Doors</td>
<td></td>
</tr>
<tr>
<td>• Internal walls and screens</td>
<td></td>
</tr>
<tr>
<td>• Finishes – internal</td>
<td></td>
</tr>
<tr>
<td>• Finishes – external</td>
<td></td>
</tr>
<tr>
<td>• Finishes – fittings</td>
<td></td>
</tr>
<tr>
<td>• Sanitary ware, taps and sanitary fittings</td>
<td></td>
</tr>
<tr>
<td>• Weather – protection</td>
<td></td>
</tr>
<tr>
<td>• Heating systems</td>
<td></td>
</tr>
<tr>
<td>• Thermal comfort</td>
<td></td>
</tr>
<tr>
<td>• Lifts</td>
<td></td>
</tr>
<tr>
<td>• Fire protection systems</td>
<td></td>
</tr>
<tr>
<td>• Fire alarm protection</td>
<td></td>
</tr>
<tr>
<td>• Security and alarm systems</td>
<td></td>
</tr>
<tr>
<td>• Access ducts and plant space</td>
<td></td>
</tr>
<tr>
<td>• ICT</td>
<td></td>
</tr>
<tr>
<td>• Landscaping</td>
<td></td>
</tr>
<tr>
<td>• Car parking and access</td>
<td></td>
</tr>
<tr>
<td>• Furniture and equipment</td>
<td></td>
</tr>
<tr>
<td>• Drainage</td>
<td></td>
</tr>
<tr>
<td>• Water installations</td>
<td></td>
</tr>
<tr>
<td>• Ventilation, refrigeration and air conditioning</td>
<td></td>
</tr>
<tr>
<td>• Mains and power circuits</td>
<td></td>
</tr>
</tbody>
</table>

The applications for Welsh timber in the Welsh Assembly buildings in Aberystwyth range from structural to decorative use, as will be shown in greater detail in the following sections.

The Welsh Assembly Government building in Aberystwyth offers ample opportunities for timber and timber based products, also in combination with other material groups and features. There is great potential for the Welsh industry to showcase this important Welsh resource.
Structure
The overriding aim is to provide buildings that are structurally sound, have minimum service lives of 60 years and comply with the requirements of the Building Regulations.

Though the exact nature of the structural frame is currently unknown, timber frame can offer suitable and viable methods of construction. The exact form of the timber frame can be discussed, but two possible approaches can be considered:

- prefabricated stud walling and sheathing to form structural timber panels, now widely used in the building industry and the most readily accessible form
- post and beam with either structural or non-structural infill panels.

Both of the above would sit well within the cultural heritage of Wales and are to an extent available from manufacturers in Wales.

Timber frame construction accounts for more than 70% of low-rise housing in the developed world. Currently the proportion of timber frame construction in England and Wales is around 8%, but is 55% in Scotland. The technique of open panel platform frame construction is most frequently used in the UK today. Timber frame has been used in buildings as high as 7 storeys in the UK, and for projects such as hospitals, offices, hotels, schools etc. One recent application includes student halls of residence in Aberystwyth.

Modern timber frame consists of relatively small section softwood studwork and rails (typically 89mm x 38mm) fixed to plywood or OSB sheathing to form panels. Unlike hardwood post and beam there are no diagonal members in the walls and the structure obtains racking resistance against wind loads primarily from the sheathing.

Long span solid timber, or timber based engineered joisted floors (such as metal web or ply-web type joists), require special consideration for office loads in combination with long spans (eg for open plan), but are achievable by such measures as reduced support spacings. Generally the depth of the beam will be considerable. Glulam or steel beams can be incorporated with timber frame for exceptional loadings, or as primary beams. For very wide floors, where a deep ceiling can be incorporated, a parallel chord trussed rafter may offer an alternative. Such trusses can also be used for flat roofs.

Timber elements combine well with other forms of construction. Timber interacts with every other material and a catalogue of customised solutions for structurally connecting different structural elements exists.
Constructing the main supporting structure in timber has the potential to rationalise the foundations, minimising ground movement and offering recycling routes in landscaping applications for the top ground layers. The façade material will also impact on the size of foundation slabs. The appointment of a lead Geotechnical Advisor at the outset who will oversee all the geotechnical aspects is key to the effective management of the project and the mitigation of ground related hazards. Effective communication from an early stage between the principal players in the project is a crucial element of successful and economic project delivery.

The Geotechnical Advisor will ensure that only specialist geotechnical contractors with appropriate skills and experience are used. Suitable Wales-based companies are available. The Geotechnical Adviser will arrange and supervise a desk study and site reconnaissance and prepare a initial geotechnical risk assessment, preliminary geotechnical appraisal and conceptual ground model. This will include the identification of any brownfield land and the measures necessary to investigate any potential contamination.

**Structural connection of timber elements**

Hardwood or softwood post and beam construction is suitable for office developments, including multi-storey. A huge variety of possible designs including traditional and modernistic are not only possible, but can be used to showcase the structural use of Welsh timber. This method of construction presents no particular issues for Welsh timber. Options include a traditional barn type structure with trusses and frames to the use of long span glulam beams supported on solid columns. Materials can be either hardwoods such as oak or softwoods such as scots pine or Douglas fir.

The external skin of post and beam can be anything from glazing to brick noggings to insulated panels.

| Combining materials, structural elements, here Timber column on reinforced concrete floor (Sibelius Hall, Lahti Finland) |
| Structural timber skin |
| Seven storey timber frame office building |
| Post and beam construction using Glulam and engineering wood products (Courtesy of Timber Engineering Connections Ltd) |
The use of green oak in conjunction with glazing infill requires special design consideration for the likely frame movement.

Many Welsh timbers have been assessed for structural purposes and have been fully tested to derive their mechanical properties and ensure compliance with visual grades and machine settings. Therefore, there should be no difficulty in finding material for most of the structural application.

There may be the instance where certain timbers wished to be used for structural applications but no structural properties are available to facilitate their use. This should not be considered a major difficulty, as stresses can be economically derived where the population of timber to be used is known and the application of the structural stresses are for a single building project.

Timber used for structural components, which is local to the site of manufacture and the construction obviously reduces the transportation element of the supply chain and adds to improving the already significant environmental credentials of timber.

### Roofs, down pipes and guttering

Roofs and guttering need to protect all occupants and users, and the building structure, from the weather. Rain should not cause unacceptable background noise levels\(^4\). Roof glazing, where provided and if appropriate, should be able to control solar gain and glare.

As recycling of rainwater to reduce the amount of mains water used (for example for watering the garden), would be beneficial, the inclusion in the design of a means of rainwater harvesting should be considered.

### Western red cedar shakes & shingles

Western red cedar has been considered the ideal species for shakes and shingles. These are used as a natural roof or wall covering, replacing the need for roof tiles and providing a different visual effect to normal cladding as a wall covering. Shakes are usually 600 mm long, usually split on one face (which gives the roof a rough textured look) and a sawn back and are thicker at the butt than shingles. Shingles are usually 400 mm to 460 mm long and have two sawn faces. Under many conditions, cedar shakes and shingles provide a good service life in their natural state and provide a visual effect like no other material.

Depending on the design and architectural concept Welsh slate could also be included, blending in well with the surrounding landscape and features. Both slate and timber would combine favourably.

---

\(^4\) Guidance given in BS 8233 1999 ‘Sound insulation and noise reduction for buildings code of practice’
Roof types;

There are five possible roof structures for the Welsh Assembly:

1. Standard truss rafter based on TR26 – it is unlikely that this will elicit an input from the Welsh timber resource. In order to comply with BS5268 Part 3 (2002) trussed rafters need to be fabricated with TR26 timber. Webs may be of lower grade material equivalent to C16. Timber for bracing need not be structural grade.

2. Bespoke design truss rafter based on other strength classes – possible from Welsh timber.

3. Cut roof – tradition carpented roof construction, possible from Welsh timber that meets the necessary strength class / grade stress requirements.

4. Stressed skin grid shell

5. Engineered wood products- here the use of Welsh timber is likely but would need to be supported by testing. Manufacturer support would need to be sought at an early stage.
External Walls

The external walls should be aesthetically pleasing, appropriate for the environment, have a long life, and be weather and vandal resistant.

<table>
<thead>
<tr>
<th>Timber based external wall panels can take many forms. They could be simply infill panels, closing off a structural frame or timber framed panels, employed as main structural panels.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timber frame is not a single system, as such, and there are several main variants:</td>
</tr>
<tr>
<td><strong>Stick built</strong></td>
</tr>
<tr>
<td>This method involves on-site fabrication of panels from packs of lumber and sheathing board. It is quite common in the US and Canada, but seldom used in the UK.</td>
</tr>
<tr>
<td><strong>Platform frame (small panels)</strong></td>
</tr>
<tr>
<td>This method uses factory prefabricated panels units (typically 2.4m high by up to 3.6m wide). The panels are “open frame” i.e. without plasterboard lining, vapour control layer or insulation; but the external face is dressed with breather membrane. Each storey is framed using floor to ceiling panels, with the floor deck becoming the platform for the next set of panels, and so on. This is the most commonly used method in the UK, having the advantage that the panels are easy to handle.</td>
</tr>
<tr>
<td><strong>Platform frame (large panels)</strong></td>
</tr>
<tr>
<td>In this variant the panels are still &quot;open&quot; i.e. without plasterboard or insulation, but are full wall size.</td>
</tr>
<tr>
<td><strong>Fully prefabricated wall panels (platform frame)</strong></td>
</tr>
<tr>
<td>In this variant the wall panels are “closed”, i.e. complete with plasterboard, vapour barrier and insulation, and they may also have windows and doors fitted. Panels may constitute complete sides of the building, or some section.</td>
</tr>
<tr>
<td><strong>Floor to floor panel frame (platform frame)</strong></td>
</tr>
<tr>
<td>In this variant the wall panels are storey height rather than floor to ceiling, with the intermediate floors being supported from the inside of the wall panel. This method has the advantage of reducing cross sectional timber shrinkage and allows the vapour barrier and insulation to be dressed continuously up the wall face.</td>
</tr>
<tr>
<td><strong>Vertical panel frame (balloon frame construction)</strong></td>
</tr>
<tr>
<td>In this variant the wall panels are building height, but obviously narrow to facilitate transport, with the intermediate floors being supported from the inside of the wall panel in a similar manner to Floor to floor panel frame. Again this method has the advantage of reducing cross sectional timber shrinkage and allows the vapour barrier and insulation to be dressed continuously up the wall face.</td>
</tr>
</tbody>
</table>
Volumetric
This involves the complete prefabrication of box units (i.e. wall and floor compartments) which form individual rooms or sections of the building. Kitchens and bathrooms may be supplied as finished pods. The disadvantage of this method is higher transport costs.
Some combination of all the above is also possible. Another variant of timber frame involves the use of timber I beams.

TF 2000 has demonstrated that timber frame construction can meet all current regulations and requirements, including fire, acoustics, thermal and airtightness.

For more information please see “TF2000: A design guide”, BRE publication 454

There is no reason why Welsh softwood (eg stress grade C16) cannot be used in timber frame, including multi-storey timber frame. A recent example of timber frame external wall construction in Wales was the student hall of residence in Aberystwyth, which employed five storey timber frame structure. The building was required to re-house over 100 students displaced by fire damage and had to be designed and built in the shortest practicable time for economic reasons. It also had to meet demanding architectural, technical and conservation requirements. For further information see BRE information paper IP19/00.
Windows and roof lights
The windows must be designed to allow the required amounts of natural light into the buildings. They must provide adequate natural ventilation along with the appropriate air tightness and heat retaining properties. Windows should be limiting solar gain to avoid unacceptably warm conditions inside the buildings.

The use of timber in windows and roof lights is well established and contemporary design makes use of extensive window facades.

A number of environmental strategies appropriate for the UK are confirmed successful, including
- Reducing heating requirements by minimising heat loss through the provision of a well insulated and sealed building envelope
- Provision of solar gain to offset fossil fuel heating
- Provision of natural ventilation to cool the building during hot weather
- Minimise solar glare and overheating through provision of solar shading
- Provision of adequate natural light to minimise the use of electrical lighting
- Educate users in the building operation to ensure the optimum use of the environmental strategies

Lighting
Natural lighting is seen to result in minimal electrical lighting requirements and the rooflight size and location is of paramount importance in maximising the use of natural daylight. For maximum natural lighting the rooflight should be positioned at about 5 m height above the finished floor level. An increase in rooflight area positively impacts on the reduction of CO₂ emission levels.

Although the design of the building has major influence on the use of lighting energy, the alteration of the building by the occupants is vital to the overall reduction in artificial lighting. The creation of spaces with reduced natural lighting, e.g. through thoughtless positioning of office furniture, results in a need for permanent artificial lighting and negates the environmental characteristics of the building.
Solar shading
The orientation and positioning of solar shades affects on overheating and glare. Refined shade design is shown to be beneficial in creating effective screens against the sun and glare. Extensive knowledge on these issues and can sought at the procurement stage and included in the specification documents.

Minimizing the use of artificial lighting to evenings and winter

Some of the Welsh timber resource, especially the hardwood resource is likely to be of lower quality, coming from small poorly shaped trees, coppice material or thinnings. Even so, this material is an important renewable resource and its economic potential can be maximised by utilising as much of this material as possible for higher value markets. The green gluing and re-engineering of timber using finger-jointing and laminating techniques will greatly assist in achieving this goal.

Welsh oak and western red cedar (see also section 2) would be ideal for the construction of window joinery. There may be problems in sourcing the quality of material required for this end use, but using ‘Green’ gluing technology with defect cutting and finger jointing will overcome this problem (see section 2 for in-depth explanation of green gluing process). There is a thriving section of craftsman in Wales who already use this technique and have already produced a number of very attractive window designs.

Window manufactured from green glued oak

Doors
Doors must meet the following main requirements:
- Fire compartmentation: Door-set specifications and locations, which are required for building compartmentation and means of escape.
- Draught-free: All external doors should be effectively draught-stripped. Where appropriate draught lobbies should be provided.
- Visual Quality: All external doors should be checked as being of appropriate quality materials and construction.
- Acoustic and security ratings: All internal and external doors and door frames in the buildings should be selected and installed so as to achieve their intended acoustic and security ratings. They should to be sized to meet anticipated means-of-escape and pedestrian traffic in the locations they are installed and areas that they serve.
- Access: All external doors should be suitable for access by motorised electric wheelchairs.
Timber doors are suitable for both internal as well as separating functions. Doors provide the required fire stopping and minimise airborne sound transmission for meeting rooms and between offices. Timber is often used in these applications in traditional as well as contemporary design.

Excellent long-term performance of wood based products

As the building(s) will be open to the public and also provide office space, the building will require the appropriate fitting of standard fire doors. These can be constructed using a laminated solid timber core (Welsh spruce) with an attractive hardwood veneer surface such as Welsh sycamore, finished with an appropriate coating to protect the pale coloured surface.

Wood doors combine well with a wide range of interior finishes

Internal walls and screens
The main requirements for these elements are that they provide appropriate fire and acoustic performance.

Timber frame wall panels are suitable for internal applications as well as external loadbearing applications. Screens and dividers are often in timber based materials to exploit the internal surface quality and effect.

In recent years timber has become increasingly popular with architects and designers and some examples are shown here.

Timber based internal screens (Courtesy of Timber Engineering Connectors Ltd)
There is no reason why Welsh softwood (e.g., stress grade C16) cannot be used in timber frame, screens and internal load-bearing and non-load-bearing walls, including multi-storey construction.

Use of timber internal screens to provide secluded, quiet areas for reading and study (Peckham Library: Courtesy of Timber Engineering Connectors Ltd)

**Internal finishes**

The main issues to be considered regarding internal finishes are:

- **WLC and Environmental impact:** The selection of all finishes and fittings should be based on whole life performance criteria and minimising environmental impact. Generic information on finishes including replacement intervals and environmental impacts can be found in publications such as "The Green Guide to Specification".

- **Quality:** All finishes should be to a high quality and fit for purpose. All surfaces shall be hard wearing and easy to clean.

- **Acoustics:** The design and choice of all finishes should be specified to meet noise requirements.

- **Disability:** Suitable colour schemes and textures should be provided to assist people with visual or hearing impairments, and to maximise the distribution of daylight within the premises.

- **HSE:** Surface reflectance and colours, and brightness management should be co-ordinated in computer areas to meet the requirements of the HSE (Health and Safety Executive) Display Screen Equipment Regulations 1992 or as amended.

- **General Aesthetic requirements:** Wood and wood-based materials should be selected from within parameters set by control samples for colour, grain, widths and general appearance and then further selected so that adjacent components have similar colours and general appearance.
Designers and specifiers of commercial development often have no control over the specification of floor finishes which is normally undertaken as a part of the fit-out contract. The choice of floor finish is generally determined by the intended use of the building and the practical requirements of an individual space. There is a number of issues affecting the final decision for finishes, such as need for waterproofing, ease of clean, particular visual, acoustic or comfort-related qualities. As a general principle, paints that utilise water or vegetable oil as a base, are produced using simple processes achieve the best environmental profiles. Those that involve the use of high-energy, complex chemical processes tend to perform least well environmentally.

The timber materials should best be chosen from sources with traceable forest management in line with sustainability requirements. All wood finishes must meet the requirements of the Welsh environmental policy and should preferably be waterborne to minimise VOC emissions.

Where opaque coatings are being used then this feature of selection and matching colour is not as important. Where clear finishes are being used this selection and matching feature may be of importance depending on the overall finish desired.

Application of coatings shall either be conducted in a factory controlled environment or by approved contractors.

The potential for formaldehyde emissions, particularly in flooring, can be minimised and guidance on this issue is given. For more information please see BRE Digest 464.

Under floor heating requires special consideration, for all timbers. Guidance is available in BS 8201. Most proprietary types of raised access flooring commonly used in offices for the provision of services eg computer/s phones/power particularly in open plan, use 600mm square chipboard panels supported at the corners by metal pedestals which typically sit on a structural concrete floor. The use of such a system will require special consideration with timber frame and timber based flooring subdeck such as chipboard on joists due to concentrated load and punching shear.
Welsh timber

Many Welsh species, both hardwoods and softwoods, are suitable for these applications. The number of available timber species in Wales provides an ideal opportunity to showcase or display the variety of textures, colours and figure available from Welsh timber. The variety of species available will enable an imaginative architect to produce themed areas based on selected species. This can be done by utilising veneers or solid section timber or a combination of both.

The timber theme can also extend into the area of flooring. It would be expected that the buildings will have a high volume of access, which will require the use of a hard wearing floor covering. End grain Welsh blocks will provide an ideal flooring substrate, being both attractive, hard wearing and produced in Wales.

Doors, flooring, stairs and handles in timber

External finishes

The main issues to be considered regarding external finishes are:

- Aesthetics and longevity: External finishes for new build should be aesthetically pleasing and durable. Wood and wood based products should be selected from within parameters set by control samples for colour, grain, widths and general appearance and then further selected so that adjacent components have similar colours and general appearance. The materials should be chosen in line with Sustainability requirements. All finishes must meet the requirements of the Welsh environmental policy.

- Protection from weather: Suitable levels of protection from weathering must be provided.

- Graffiti resistant: All finishes should facilitate the removal of graffiti.

The service life of wood in any one product exposure relies on a hierarchy of choices starting with

1. design and build
2. natural durability
3. enhancing durability

In all cases the benefits of good design and the contribution of natural durability of any Welsh timbers selected should be maximised.

Where uncoated wood might be used in exterior applications (such as WRC cladding) then the matching of colour and grain as described is sensible as this is likely to ensure even
weathering during exposure.

Where coatings are being used, either semi-transparent or opaque, then this feature of selection and matching colour is not as important.

Clear finishes are not recommended for external use.

Application of coatings shall either be conducted in factory controlled environment or by approved contractors.

Graffiti resistant coatings are only available for concrete and masonry. Coatings on wood are not specifically graffiti resistant but equally they don’t hinder the removal of graffiti.

External components, including timber based components particularly external timber, will require a maintenance schedule. This will ensure that the materials will weather evenly and perform at their best throughout the service life of the structure and beyond.

As can be seen from the description of the timbers available within Wales (section 2), many do not have a high degree of natural durability. Only Oak, Larch and western red cedar show natural durability suitable for external use and then in carefully planned applications, and for these species we are only referring to the heartwood. Therefore, it can be envisaged that there are possible applications for timber where durability can become a concern and there are ways that this can be controlled and these will depend on the client needs and perceptions of the building. If there is a need to meet the highest environmental standards the use of chemical preservatives may be discouraged, other methods of building in durability will need to be sought. Products such as Tanalith E should not be totally excluded from the design process as they can offer protection and are available within Wales (Overview Welsh suppliers, section 3). The correct method of specification of preservatives for timber can be given, should this approach be adopted.

The first obvious way of ensuring durability is to select naturally durable species with the appropriate properties for the end use application. This should be done according to EN355, EN350 and EN460. However, the range of potential species is limited. Alternatives to chemical preservative treatments exist based on modification of the timber in some way and these can include such processes as:

<table>
<thead>
<tr>
<th>Durability Class - Heartwood</th>
<th>Service Life Prediction (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitka spruce, Scots pine, Douglas fir</td>
<td>15</td>
</tr>
<tr>
<td>Larch, Western red cedar</td>
<td>30</td>
</tr>
<tr>
<td>Oak, Sweet chestnut</td>
<td>60</td>
</tr>
</tbody>
</table>
• Heat treated timber
• Hot oil treatments
• Acetylation

These processes are being increasingly used within continental Europe but in many ways may still be regarded as experimental, particularly with regard to the UK climate. At this time there is no UK based commercial production facilities and materials will need to be sent to the continent for treatment.

An alternative, passive approach to durability issues is to maintain the timbers equilibrium moisture content below the risk threshold for decay (nominally around 20%). There are a number of ways in which this can be achieved:

• Defensive design for timbers at risk
• Correct detail specification
• Surface treatments and end grain sealing

### Finishes: Fittings

All external and internal fittings should be of good and unblemished appearance. Fittings should be selected to ensure consistent appearance throughout the facilities.

Wood based fittings, in skirting and other applications, are common and proven. Fitted desks and shelving can provide additional features to an office environment, in line with the overall architectural concept of the building.

Fixings selected for exterior use shall possess suitable weathering resistance and not corrode or react with any other materials and substrates.

The application of coatings and finishes shall be conducted in factory controlled environment.

Galvanised or stainless steel fixings are used with timbers such as WRC

---

External use of native species (University of Wood Science, Biel Switzerland)

Wood based products can be combined in traditional and contemporary interiors, merging well with other materials and shapes (courtesy of Derek Swalwell Architecture photography)
The Welsh resource is well suited to offer a variety of options for such applications.

Weather protection
The main weather protection issues to consider are:

- The building envelope and all aspects of the building fabric and installations must be able to prevent deleterious penetration by rain, snow and wind, as well as rising moisture or splash back from the ground. There should be no visible signs of entry by rain or snow.

- There must be no discomfort to occupants as a result of accidental weather penetration or draughts.

- There must be no discomfort to occupants as a result of noise generated by rain falling on the roof.

- There must be no sign of moisture rising from the ground.
Wooden solar shading can be used to minimise solar glare and control solar gain.

Consideration should be given to maximising the protective effect that the design of the building can have on the performance of the materials chosen (e.g. the eaves of traditional alpine buildings offer some weather protection to the wooden walls of the buildings).

Establish predominant weather direction and chose a design that fits with materials used for external walls, desired performance and appearance. For example the use of exposed end grains facing into the prevailing weather direction (probably S or SW) should be avoided through design.

Heating systems
The heating system should provide

- the desired inside temperature (DIT) for occupied spaces.
- efficient operation under part occupancy (outside normal office hours).
- the minimum fuel consumption
- the minimum environmental impact.
Biomass, resourced from Wales in combination with other passive heat gaining system, such as solar panels, could provide the heating required and minimal environmental impact.

<table>
<thead>
<tr>
<th>Combine resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood pellets (courtesy of welshbiofuels Ltd)</td>
</tr>
</tbody>
</table>

Development of a renewable-energy sector in Wales is a key target for the National Assembly Government as set out in the Assembly’s strategy for trees and woodlands. An initial search for a suppliers within 50 miles of Aberystwyth has shown encouraging potential for using biomass in the New Welsh Assembly buildings in Aberystwyth.

In Wales there is an existing network of biomass suppliers and technology. The Welsh Botanical Gardens and the Welsh Assembly recently built have opted for biomass based energy. Consultancy should be sought early on in the procurement stage.

| Biomass technology already used in public buildings in Wales (Courtesy of Archiwood) |

**Thermal comfort**

The buildings will be required to:

- Avoid excessive vertical temperature gradients during the heating season. Temperatures at ceiling and floor levels, should not deviate from the temperature at 1m above the floor by more than 2°C for more than 1 hour during occupancy, unless this is attributable to high metabolic gains.
- Maintain the fabric (floor, ceiling, and walls) temperature within 3°C of the air temperature, as measured 1m above the floor in the centre of the room, during occupied hours.
- Limit the summertime internal temperature to 25°C for 95% of the occupied hours.
Timber frame structures generally warm up quickly, which lends them well to buildings that are used part-time. The thermal comfort functional requirements described above can be met in timber based buildings, which is also related to the thermal performance of the building, including airtightness. Timber frame buildings conform easily with the revised Building Regulations Part L.

**Lifts**

All building users must have access to all facilities in the buildings. Lifts must be suitable for disabled use, with dimensions in accordance with the guidance in the Disability Discrimination Act.

Special provision for differential movement in multi-storey timber frame is required for lift shafts, staircases and services. Special provision for differential movement is also required where the timber frame interfaces with different forms of construction (such as concrete or steel frame) and also other forms of timber construction where the level of cross grain timber is different as in posts and beams.

Timber is a natural, anisotropic material which exhibits dimensional movement with changes in moisture content. Of particular importance is shrinkage in the cross-grain direction. Timber which is classed as “Kiln Dried” is usually at around 20% moisture content. The in-service conditions for timber inside a heated building are around 10%. Therefore for multi-storey timber frame special consideration has to be made for shrinkage movement, in particular when the building is clad with other materials such as masonry.

Methods of reducing differential movement due to timber shrinkage include using specially pre-dried timber, careful protection of timber during transport and storage, and reducing the amount of cross grain timber in the construction (eg solid timber joists, top and bottom rails) and others adopted by the timber industry.
Fire Protection Systems

The fire protection system should be provided in accordance with Building Control/Fire Officer and Insurer’s requirements. In addition a gaseous fire suppression system for the server room must be provided.

Timber in the construction of dwellings has been used for centuries and proven that it can achieve adequate Performance, especially for large-section timber. Ease of combustion is largely a function of the surface-area-to-volume ratio; this is why wood shavings will burn readily, and large-section timber beams can be left unprotected and will not support fire growth unless there is an additional heat source to maintain the burning process. Solid timber ignites in the presence of a pilot flame at surface temperatures between 300 to 365 °C, depending on timber properties such as density and moisture content; these surface temperatures can be reached upon short to medium term exposure to about 400 to 500 °C. Panel products such as plywood or particleboard have similar ignition properties to solid wood.

The fire properties of timber can be modified using surface treatments such as intumescent coatings and impregnated inorganic salts. These treatments improve the fire resistance of timber. The rate at which timber combusts is influenced by a number of properties including density, timber species, moisture content and the surface area-to-volume ratio. The rate of combustion can be reduced with fire retardant treatments. Being an organic and anisotropic material, timber also has a highly complex reaction to fire with many of the thermal and chemical properties differing in the three orthogonal directions. Properties also change with temperature and time. The one property remaining relatively stable is the charring rate. Charred timber is an extremely good insulator, with the conductivity of charcoal being about one sixth of solid timber. Behind the layer of charcoal is the pyrolysis zone where the chemical composition of the timber gradually changes to release combustible gases. Because charcoal is such a good insulator and timber is a natural insulator with good thermal diffusivity the thickness of the advancing pyrolytic layer is notionally only 5 mm, leaving the remaining timber section unaffected by the effects of the fire.

Both the predictable rate of charring and unaffected properties of the residual section ensure that the structural response of timber to fire can be easily...
predicted by calculation. This forms the basis for fire
engineering design of timber structures. When the cross-
section of timber members is insufficient to resist the
applied structural load, protection can be provided by a
combination of timber panelling, mineral board and rock
fibre insulating materials.

Following changes in the Building Regulations 1991,
timber frame buildings could be constructed to a height
of 20m in England and Wales for one hour fire
resistance, typically eight storeys. At that time Building
Standards in Scotland only permitted combustible
materials in separating wall construction to a height of
11 m. Since then, fire tests conducted on the TF2000
building at BRE Cardington helped to harmonise
standards across the UK, establishing the limit for UK
timber frame building at 18 m height for one hour fire
resistance. This applies to the structural use of timber in
separating and external walls although there may still be
limitations on the use of timber in other parts of the
building structure. The main limitations are summarised
in Table 1. A more detailed account is contained in
BRE Digest and BRE Digest 454, The Timber Frame
Design Guide.

The use of sprinklers allows to extent and application of
timber in buildings, internal linings as well as external
claddings

Extensive work has been undertaken on timber facades
in Germany, Austria and Switzerland. Event focused,
probabilistic design approaches are studied and
extensively researched in Finland.

As long as timber species and densities are matched to
requirements, protection guidelines observed and fixing
patterns for protective cladding met, there should be no
adverse impact from using Welsh timber.
Access ducts and plant space
The design will have to ensure that all access systems and plant space requirements are such that the facilities can be satisfactorily maintained and commissioned with the minimum of downtime. Such installations and access should comply with health and safety recommendations for safe working, lifting, access and exposure to environmental conditions.

<table>
<thead>
<tr>
<th>Engineered wood products offer exciting new possibilities, allowing flexible plant space and provision of services. Metal webbed timber joists (as shown) are being used extensively in the industry and have a proven track record. Maintenance requirements of services and plant space should be kept in mind early in the design stage.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timber products offer flexible joist systems, which can accommodate services for plant equipment and duct space</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The use of Welsh timber in engineered wood products has to be assessed in detail. A barrier might be the availability of manufacturers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIPs walls are engineered wood wall products</td>
</tr>
</tbody>
</table>

ICT
The following services will need to be accommodated in the structure:

- the provision of incoming data ducting for telecommunications serving the building – ductwork for up to 3 separate telecom providers should be installed
- containment and cabling suitable for CAT6
- a minimum of 2 data points for each person – refer to RDS.
- at least 50 data points for the Server Room
- a minimum of 200 additional data points for printers, touchdown areas, etc.
These items will not be influenced by the use of timber. All functional requirements can be met with timber based solutions. Easy access ceiling panels should simplify maintenance. Experience from the Integer house study can be used to optimise initial installation for services and supplies to simplify alterations and changes to IT support during the lifetime of the building.

For more information see “The Integer House” Building Homes, January 1999

<table>
<thead>
<tr>
<th>Landscaping</th>
</tr>
</thead>
<tbody>
<tr>
<td>All landscaping and fencing should be of good quality and fit for their intended purposes, and should create a positive workplace experience for the users. All such areas must have durability to withstand heavy usage.</td>
</tr>
</tbody>
</table>

Timber has extensive use in landscaping and external structural and non-structural applications ranging from fencing and decking to children’s playground and road barriers. External landscaping provides an ideal opportunity to use timber to its best effect. To ensure the quality of all landscaping and fencing, deeming it fit for its intended purpose, to create a positive workplace experience for the users and meet respective policies, the following things should be considered:

- a seating area for relaxation and eating outdoors shall be provided.
- separate facilities for bicycle storage and a smoking shelter.
- car parking ports and shelters
- playground for nursery
- signage and lamp posts
- fencing, screens and acoustic barriers
- Garden landscaping timbers, path edges, benches, decking area, raised beds, gazebos, trellis work

All such end uses must have durability matched to end use and be able to withstand heavy usage.
Seating or relaxation areas can be constructed using timber decking, using selected Welsh softwood species such as Douglas fir, larch, Western red cedar and selected hardwoods such as oak or sweet chestnut. To increase durability, it may be advantageous to preservative treat the softwood decks. Oak and sweet chestnut can be used in their raw state, as both have good natural durability, although no sapwood can be allowed in the decking sections due to its low durability. All fixings must be galvanised or stainless steel due to the acidic nature of several of the named species.

**Bollards and Lamp columns**

To improve the visual impact of landscaped areas, it is possible to construct both lamp columns and bollards in timber. Depending on the ground fixing of these components, a durable hardwood such as oak would be required. The components can also be made up of smaller section timber by utilising finger-jointing and laminating technology. This can be accomplished either in the wet or dry state.

**Fencing**

This is an ideal opportunity to use preservative treated Welsh softwoods, such as spruce or Douglas fir. Modern methods of fence construction provide a wide range of designs which provide the security with aesthetic quality.

There is also potential for using timber sculptures, fabricated by local craftsman. Welsh timber can also find application in landscaping materials, such as bark mulch, dyed or natural wood chip.

A list of suitable contacts for the above products in Wales has been assembled in section 3 of this document.


Car parking & access
There should be sufficient provision of facilities for safe and secure covered storage of cycles, wheelchairs and buggies. Car parks, roads, pathways and cycle routes should have a design life of 40 years.

Opportunities for Welsh timber are ample in these applications. The resource could for example be used to form a louvered sided long eaves bicycle shelter and adjoining storage unit. Some applications have been shown here. There are no limitations to the extent of timber use. Welsh timber would be well suited and also complement and blend into the existing landscape.

Furniture and equipment
Fixed furniture and equipment, including blinds, need to be provided.

In this area there is great opportunity not only to use the Welsh resource but also Welsh craftsmanship. Public and official furniture custom made in local timbers by local craftsman will set the building apart from other public buildings.

There is also great opportunity for re-engineered material to produce worktops, desktops, reception counter, furniture, flooring blocks, shelving units, blinds, dining furniture in canteen, maximising the aesthetic benefits of the wood products.
Wales has been undergoing a process of rural development for a number of years and large numbers of craftsmen exist who utilise Welsh timber to construct a wide range of furniture and associated equipment, either bespoke or semi-mass produced. This would provide another opportunity to display the craftsmanship present within Wales and the abundance of natural materials available.

Great opportunities for Welsh timber in modern interior design (Courtesy of Derek Swalwell architectural photography)

Signage

Appropriate signage in the facilities and throughout the premises must be provided. The signs should provide clear directions for all users (including those with disabilities) and be aesthetically acceptable. Standard signage should be used across the facilities.

Signs can be produced in any number of Welsh timber species to a standard size format. Lettering can be achieved by either routing the letters directly into the surface and staining to make the signage stand out or by the application of alternative material letters direct to the surface.

The following issues will not be affected or influenced by the use of timber or timber based systems. They are included in this document for completeness only.

Security and alarm systems

The Welsh Assembly will have special security requirements. These will have to be considered throughout the concept and design stage. The systems will have to provide:

- Security, x-rays, intruder, access control and CCTV systems for both internal and external areas,
- Fail-safe operation and installation. All installed systems should be compatible with other monitoring systems installed at the site
- Access systems to control the movement of personnel into defined spaces.
- The ability to meet ‘Secured By Design’ requirements.
A CCTV system for surveillance of external areas of the building and the entrance area within the building. Columns and supports should be unobtrusive and match other street furniture equipment. A colour system should be used with full video recording for all cameras. Cameras should have point, tilt and zoom capability. Secure web access including camera control should be provided. The provision of a remote monitoring capability should be considered.

A stand alone access control system with time recording and personal identification swipe cards for entry/exit and segmentation of facilities in the buildings. There should be corporate management of access control systems, with facilities for linking with other Welsh Assembly buildings.

An intruder alarm system with panic buttons linking to the security system.

Physical barriers to restrict vehicular access to the site at specific times. The barrier should be controlled from the security system and by the use of the identification cards. Voice and camera links should be included to allow communication from each barrier.

Systems designed to allow expansion and the provision of additional features in the future with minimum disruption. The systems must take the possibility of the floors being subdivided/sub-let into account.

**Drainage**

The drainage systems should provide safe effective removal of wastewater, surface water and liquid waste from the activities on the site. This requires:

- inspection and maintenance processes to ensure there are no interruptions to drainage services
- the proper interception of fatty wastes and appropriate arrangements for their disposal
- surface water drainage systems to be kept clear of silt and matter (biological or litter etc.) that may cause reduced flow capacity or blockage
- liaison with the respective waste water agencies to establish the permitted discharge rates and the connection points to the public foul sewer network – provision of oil traps and attenuation as required
- implementation, where possible, of measures to reduce the effect of the proposed surface water drainage system on the receiving environment, in accordance with the CIRIA publication *Sustainable Urban Drainage Systems*
- no internal foul manholes – they are not acceptable.

**Water installations**

It is important to ensure that continuous supplies of high quality potable and hot water are available to all parts of facilities that use water. The use of grey rain water as appropriate is recommended. Issues to consider include:

- for the purposes of hand washing and showers the temperature should not exceed 43°C and should not be less than 35°C at the delivery point
• where Domestic Hot Water (DHW) is supplied without thermostatic control, all taps should be appropriately labelled

• checks for Legionella should be made at intervals as recommended in Health & Safety Series booklet HS (G) 70 – *The Control of Legionellosis including Legionnaires Disease*.

**Ventilation, refrigeration and air conditioning**
The facilities must be of a quality to provide the ventilation required for a healthy environment that is conducive to the activity being carried out at that particular time. Due consideration should be given to recovering waste heat from ventilated air and the use of passive ventilation strategies. Refrigerant based cooling systems should only be used where absolutely necessary, and not where passive means, such as ventilation air drawn through soil pipes or ground water/river water coils, can satisfy requirements.

Noise from mechanical ventilation and any ancillary equipment should not interfere with the office functions or exceed the noise criteria given in the RDS. This includes airborne noise transfer between rooms and from outside under summertime ventilation conditions with high ambient temperatures.

**Mains and power circuits**
The power circuits must be of an operable and safe standard. The distribution should be designed to allow flexibility in supplying and metering individual areas or floors.

**Lighting**
Lighting should provide appropriate levels of illumination for the activity being undertaken within each area. Artificial lighting is to be minimised and only used when necessary, due to the type of occupancy or use, or lack of daylight.

External lighting should be installed for security purposes, and provided to all car parks, roads and external paved areas. All external lighting fittings should be selected to minimise light pollution and sky-glare.

Occupancy control should be fitted to all intermittently occupied areas, including meeting rooms, corridors and stairways. Appropriate lighting system controls for maximising the use of daylight should be installed.

**Gas installations**
Gas installations and appliances should be provided where required, and installed in accordance with appropriate regulations.

**Lightning protection**
The provision of systems that protect the buildings against lighting strikes should be considered. A lightning protection study should be carried out to evaluate the need to install such a system.

**Building management systems**
A building management system (BMS), complete with head end computer, printer and keyboard should be provided. All such systems should have fail-safe provision, be operational at all required times and be compatible with other monitoring systems installed at the sites. The BMS should monitor and control all...
mechanical and electrical systems including heating, internal lighting, external lighting, lifts, security, fire alarms and metering.

**Metering and sub-metering**
An adequate number of appropriately located remote automatic read-out meters should be provided to satisfy the utility suppliers, the Building Regulations, and the needs of occupiers to comply with statutory requirements and any obligations they have under Energy and Environment monitoring and targeting. Logging of consumption by the occupier must be possible.
CHAPTER 2
THE WELSH TIMBER RESOURCE

Wales holds vast stocks of standing timber of varying quality. It also has dynamic sawmilling and secondary processing facilities. There are major growers, such as the Forestry Commission for Wales (FC), holding large forests over much of the country. In addition and equally important in terms of national diversity, there are many privately owned estate woodlands, many with their own conversion and processing equipment. Whilst the Forestry Commission for Wales (FC) will be able to supply to market large volumes of single species, the private grower has by necessity a greater diversity of species within a given site or estate. Therefore, the material can be drawn from the most appropriate source for secondary processing and distribution. Timber local to the site of manufacture of the major structural components or to the construction site obviously reduces the transportation element of the supply chain and adds to improving the already significant "Environmental Credentials" of timber.

The resource, in terms of location, occupies sites appropriate to the growth requirements of the main commercial species. The sites range from the highlands of North Wales to the gentler postural landscape in the south of the country. Many plantations contain species of high commercial importance and include both broadleaf and coniferous species such as:

- Sitka spruce -and in some locations Norway spruce
- Larch -FC and private ownership
- Douglas fir -FC and private ownership
- Scots pine (Corsican and lodge pole) -FC and private ownership
- Western red cedar-No exact data
- Oak - FC and private ownership
- Ash - FC and private ownership
- Beech - FC and private ownership
- Elm - Private ownership
- Sycamore - FC and private ownership
- Sweet Chestnut - FC and private ownership
- Coppiced grown material and non commercial species

Out of necessity this study will mainly concentrate on the major commercial species as they are likely to provide most of the timber suitable for use in the Welsh Assembly Government buildings in Aberystwyth. However, timber species with little current commercial value should not be entirely overlooked as modern processing technology can be used to add significant value to these species. Re-engineering with the use of "green" adhesive technology finds high valued added end use applications such as window, flooring, stair parts worktops and furniture components.
Standing tree coverage by species

The estimated ground coverage of the Welsh timber resource, by hectares, for each of the major timber species is shown in Tables 1, 2 & 3. The distribution of the standing timber resource within Wales is almost evenly spread across the country. The private grower has the highest occurrence within mid-Wales and the Forestry Commission maintain an even presence throughout the country.5

Table 2 shows the woodland resources for Wales by county. This should not be mistaken for the usable resource. These figures also include no longer clear felling stands of timber, providing an amenity cover with poorer quality growths and species that have little commercial value.

Table 1: Woodland resource by county5

<table>
<thead>
<tr>
<th>County</th>
<th>Woodland size (hectares)</th>
<th>Total area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 or more</td>
<td>0.1-&lt;2</td>
</tr>
<tr>
<td>Gwynedd</td>
<td>46840</td>
<td>1775</td>
</tr>
<tr>
<td>Clwyd</td>
<td>23845</td>
<td>425</td>
</tr>
<tr>
<td>Dyfed</td>
<td>73487</td>
<td>4329</td>
</tr>
<tr>
<td>Powys</td>
<td>68194</td>
<td>6888</td>
</tr>
<tr>
<td>Glamorgan</td>
<td>39614</td>
<td>2349</td>
</tr>
<tr>
<td>Gwent</td>
<td>18054</td>
<td>968</td>
</tr>
</tbody>
</table>

Table 2: Total supply of named species by ground cover for the Forestry Commission and private ownership5

<table>
<thead>
<tr>
<th>Species</th>
<th>Forestry Commission (Area - hectares)</th>
<th>Private ownership (Area - hectares)</th>
<th>All ownerships (Area - hectares)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitka spruce</td>
<td>55322</td>
<td>25993</td>
<td>81316</td>
</tr>
<tr>
<td>Scots and Corsican pine</td>
<td>5166</td>
<td>2672</td>
<td>7838</td>
</tr>
<tr>
<td>Douglas fir</td>
<td>5458</td>
<td>5357</td>
<td>10816</td>
</tr>
<tr>
<td>Larch</td>
<td>11999</td>
<td>10122</td>
<td>22212</td>
</tr>
<tr>
<td>Oak</td>
<td>4389</td>
<td>33703</td>
<td>38092</td>
</tr>
<tr>
<td>Ash</td>
<td>1196</td>
<td>16985</td>
<td>18181</td>
</tr>
<tr>
<td>Beech</td>
<td>2269</td>
<td>5100</td>
<td>7369</td>
</tr>
<tr>
<td>Elm</td>
<td>0</td>
<td>123</td>
<td>123</td>
</tr>
<tr>
<td>Sycamore</td>
<td>205</td>
<td>5919</td>
<td>6124</td>
</tr>
<tr>
<td>Sweet chestnut</td>
<td>130</td>
<td>402</td>
<td>532</td>
</tr>
</tbody>
</table>

5 Source: National Inventory of woodlands and trees- Wales, Forestry Commission, 1997
The ownership of the resource (Table 3) by species shows that the Forestry Commission holds the majority of the softwood resource, about twice the amount for each species compared to the private owner. However, private owners hold the higher proportion of the hardwood resource.

### Table 3: Supply by quality category for standing tree cover (hectares)

<table>
<thead>
<tr>
<th>Species</th>
<th>Forestry Commission</th>
<th>Private ownership</th>
<th>All ownerships</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Category 1</td>
<td>Category 2</td>
<td>Category 1</td>
</tr>
<tr>
<td>Sitka spruce</td>
<td>50137</td>
<td>5186</td>
<td>23601</td>
</tr>
<tr>
<td>Scots and Corsican pine</td>
<td>4757</td>
<td>410</td>
<td>5465</td>
</tr>
<tr>
<td>Douglas fir</td>
<td>5385</td>
<td>73</td>
<td>5222</td>
</tr>
<tr>
<td>Larch</td>
<td>15703</td>
<td>296</td>
<td>9729</td>
</tr>
<tr>
<td>Oak</td>
<td>2000</td>
<td>2389</td>
<td>9399</td>
</tr>
<tr>
<td>Ash</td>
<td>494</td>
<td>702</td>
<td>6908</td>
</tr>
<tr>
<td>Beech</td>
<td>1800</td>
<td>469</td>
<td>2736</td>
</tr>
<tr>
<td>Elm</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sycamore</td>
<td>58</td>
<td>147</td>
<td>1750</td>
</tr>
<tr>
<td>Sweet chestnut</td>
<td>42</td>
<td>88</td>
<td>181</td>
</tr>
</tbody>
</table>

In Table 3 the timber resource by species is displayed in “High Forest” categories:

- **Category 1**: These are woodlands which are, or could become, capable of producing wood of a size and quality suitable for sawlogs.
- **Category 2**: Classified as stands of lower quality than category 1.

Therefore, not all the timber resource within Wales is suitable for conversion to quality end use material. For the hardwoods, such as Elm, the resource is limited in size and quality. Similarly for “High Forest” category 2, including small diameter hardwood logs have limited application. However, re-engineering and modern processing activities can reclaim much of this low quality material for high added value end uses. Unfortunately there are no current processors within Wales but a limited number exist in other parts of the UK.

It has not been possible to determine the annual conversion rates for the species listed in this document (m³production/species/year). This is mainly due to the fact that producers do not wish to reveal the nature and size of their business. Whilst this is understandable from a commercial stand point, it does hamper the effective determination of what can be achieved overall. Without this information an accurate picture of the resources to market cannot be established. This has potential to be one of the main drawbacks to the effective use of the Welsh supply chain.

BSW⁶ have supplied basic production figures for two of their Welsh sawmills:

---

⁶ BSW plc is a chain of large UK sawmills
New Bridge on Wye: Mid Wales
- Mixed production of Douglas fir, larch and spruce.
- They take in 185,000 m³ of roundwood per year
- They produce 108,000 m³ of sawn rectangular timber (mostly machine strength graded)

Senghenydd: South Wales:
- Specialise in short log length and small diameter (no information on species)
- They take in 99,000 m³ of roundwood annually
- They produce 55,000 m³ of sawn rectangular timber primarily for the fencing market.

Although only one example of the scale of annual production could be found, the production rates are encouraging. If similar production rates were repeated across Wales, there would be sufficient timber of the appropriate quality produced each year form the Welsh resource to facilitate its use in the construction of the Welsh Assembly Government building in Aberystwyth.

The supply chain and associated activities
Evidence from a number of reports indicates that the Welsh supply chain is incoherent and lacks integration. It is also limited by the scale of contributors to it. The majority of timber producers are relatively small and about 70% have no markets outside of Wales. Many of these producers have yet to develop effective long term market strategies. For the Welsh harvesting / transport sectors profitability remains one of the main issues. However, many of the issues, such as load limitation, fuel costs, and infrastructure are not exclusive to the Welsh transport industry. It is to be considered that Welsh operators are generally small, which negatively impacts on flexibility of the services offered, loosing the benefits of economy of scale.

To make effective use of the Welsh supply chain the procurement of materials and services will need to be actively sought by those making the procurement decisions. The supply chain can not be relied upon to make an effective contribution without being cultivated by a central authority.

It is of course of vital importance that as much of the Welsh timber resource is used in the construction of the Welsh Assembly Government buildings. To successfully achieve this on a cost competitive basis the timber resource needs to be serviced by a full range of secondary wood processing and finishing activities. Therefore, it has to be demonstrated that both the availability of timber from within Wales but also the associated secondary processing activities are suitable. The main sectors for consideration may be categorised as follows:

- Saw milling
- Timber drying (kiln or air dry)
- Strength and appearance grading
- Timber framing
- Preservative treatment
- Timber merchants
- Wood based panel manufactures

---

7 Welsh Forest Industry – Mapping and Benchmarking the Forest Industry” Report by Jaakko Pöyry, November 2004
• Joinery services, including window and door manufacture, furniture and cabinet making, flooring and decorative arts (turning and carving).
• Consultancy and advice

It can be seen in section 3 of this report that much of this secondary processing activity can be successfully sourced from within Wales. The scale of such operations varies from major saw millers and timber processes in the UK such as a BSW (at New Bridge on Wye) to private estate saw mills like Mostyn Sawmill, through to individual crafts working in wood with a unique and personal take on the material.

It should also be remembered that whilst the initial major input of timber will be rectangular section with possibly some timber in the round, there is a biomass element to the timber processing industries. These produce and process wood based fuels from forest residues. Wales has an active bio-mass fuel industry using the sustainable resource base for heating or combined heat and power applications. Over time the bio-mass application of timber, with its low carbon per Kilowatt hour compared to fossil fuels, will considerably add to the sustainability of the new Welsh Assembly Government buildings in Aberystwyth.

A brief description of the major timber species

The appearance and technical performance of timber from the Welsh reserve is varied. Here the major commercial species are reviewed.

**Coniferous species**

**Sitka Spruce** (*Picea sitchensis*)

<table>
<thead>
<tr>
<th>Grain pattern</th>
</tr>
</thead>
</table>

**Dimensional movement (%)**

<table>
<thead>
<tr>
<th>Shrinkage (green to 12%)</th>
<th>tangential</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>radial</td>
<td>3</td>
</tr>
</tbody>
</table>

**Moisture content**

| 90%          | 19 |
| 60%          | 12.5 |

**Movement**

| tangential | 1.3 |
| radial     | 0.9 |

**Natural durability**

The timber is classified as "slightly durable" or class 4 in EN350: Part1. The heartwood is classified "resistant" or class 3 to preservative treatment but the sapwood is "moderately resistant" or class 2 in EN350: Part2

**Strength grading**

<table>
<thead>
<tr>
<th>Stress grades</th>
<th>C16 / Reject</th>
<th>C16 / C24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual grades (BS4978)</td>
<td>GS = C14</td>
<td>SS = C18</td>
</tr>
</tbody>
</table>

* when subjected to relative humidity changes from 90% to 60%
Sitka spruce is probably the most important commercial timber species grown within the UK. The average density (at 12 % moisture content) is 450Kg/m³ (given in BS5268: Part 2 annex A). It accounts for most of the structural timber produced by the Forestry Commission and is the most abundant plantation timber. The majority of Welsh produced Sitka spruce is fast grown which results in a low weight and course texture.

The timber is white to cream and there is no noticeable distinction between the heart and the sapwood. The knots are pale and do not stand out from the sounding timber. The timber does not always dry evenly with the occasional occurrence of collapse. It has a tendency to distort on drying, particularly twist and cup. This can be significantly reduced by good drying practice.

The timber works easily with hand and machine tools, though chipping of the knots can prove troublesome. The bands of soft springwood have a tendency to tear. Sitka finishes adequately in most machine operations and can be glued satisfactorily.

**Scots pine (pinus sylvestris)**

Sometimes sold under the name “British pines”, which can be a mix of Scots pine and Corsican pine. For structural use these two species are not distinguished.

<table>
<thead>
<tr>
<th>Dimensional movement (%)</th>
<th>Shrinkage (green to 12%)</th>
<th>Moisture content</th>
<th>Movement* “medium”</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>tangential</td>
<td>90%</td>
<td>tangential 2.1</td>
</tr>
<tr>
<td></td>
<td>radial</td>
<td>60%</td>
<td>radial 0.9</td>
</tr>
</tbody>
</table>

Natural durability

The timber is classified as "slightly-durable" or class 4 in EN350: Part 1. The heartwood is classified "resistant" or class 3 to preservative treatment but the sapwood is "permeable" or class 1 in EN350: Part 2 to preservative treatment.

Strength grading

<table>
<thead>
<tr>
<th>Stress grades</th>
<th>Visual grades (BS4978)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C16 / Reject</td>
<td>GS = C14</td>
</tr>
<tr>
<td>C16 / C24</td>
<td>SS = C22</td>
</tr>
</tbody>
</table>

* when subjected to relative humidity changes from 90% to 60%

Welsh Scots pine has an even, moderately slow growth rate, which results in a good density softwood. The average density for Scots pine is 540 kg/m³ (BS5268: Part 2).

There is a distinct difference between the heart and the sapwood; the heart being darker and reddish brown, which may be resinous, compared to the paler coloured sapwood. The timber dries quickly with little distortion or degradation. If the sapwood is not properly treated it is liable to blue stain attack. It also needs to be kiln dried as soon after felling as possible.

In general the timber works well with hand and power tools, though the denser material may offer greater resistance to cutting with resin build-up. Loose knot can result from kiln drying and fall out as the timber is...
worked. Sharp cutting edges should be maintained as the soft earlywood is prone to tearing when being worked. The timber takes a stain well and glues satisfactorily.

**Douglas fir (Pseudotsuga menziesii)**

<table>
<thead>
<tr>
<th>Dimensional movement (%)</th>
<th>Shrinkage (green to 12%)</th>
<th>tangential 4</th>
<th>radial 2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture content</td>
<td>90% 19</td>
<td>60% 12.5</td>
<td></td>
</tr>
<tr>
<td>Movement*</td>
<td>tangential 1.5</td>
<td>radial 1.2</td>
<td></td>
</tr>
</tbody>
</table>

Natural durability

The timber is classified as "slightly-durable" or class 4 in EN350: Part 1. The heartwood is classified "extremely resistant" or class 4 to preservative treatment but the sapwood is "moderately resistant" or class 2 in EN350: Part 2.

Strength grading

- Stress grades
  - GS = C14
  - SS = C18*  
- Visual grades (BS4978)
  - GS = C14
  - SS = C18*

* when subjected to relative humidity changes from 90% to 60%

"SS visual grade in large sizes (in excess of 200,000mm²) = C24*, comparable with imported North American Douglas fir)

Douglas fir has a density of 520 Kg/m³ (BS5268: Part 2). The heartwood is a mellow, red brown that is clearly distinct from the lighter sapwood. The contrast between the early and late wood of the growth-rings shows clearly as features on a plane-sawn surface. In general the timber is straight grained though on occasionally wavy or spiral grain may be present. UK grown timber has about the same rate of growth and visual appearance as second-generation North American sources and has about the same strength properties. The UK timber has a high stiffness, which is not reflected in the strength classes.

The timber is acidic, which can accelerate the rate of corrosion of unprotected ferrous metals (inserted as fixings for example). On contact with iron it will also produce a blue-black chemical stain.

The timber works well with hand and power tools. The hard loose knots can be troublesome when machining the timber and can damage cutters. The faster grown material is prone to splitting when cross cutting. In machining the soft earlywood can be compressed by dull tools. Care has to be taken as such damage can later expand to form ridges.

The timber takes screws well, but care should be taken when nailing. To avoid splitting of the timber, especially near the edges, pre-drilling should be considered. In general the timber takes finishes well. Resinous material may require kiln drying before the application of paints, varnishes or stains. The timber generally glues well.
Larch (Larix spp.)

<table>
<thead>
<tr>
<th>Dimensional movement (%) (given for Larix deciduas)</th>
<th>Shrinkage (green to 12%)</th>
<th>Moisture content</th>
<th>Movement* “small”</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>tangential</td>
<td>90%</td>
<td>tangential</td>
</tr>
<tr>
<td></td>
<td>radial</td>
<td>60%</td>
<td>radial</td>
</tr>
<tr>
<td></td>
<td>4.5</td>
<td>23</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>13</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Natural durability

The timber is classified as "moderately durable" or class 3 in EN350: Part 1. The heartwood is classified "extremely resistant" or class 4 to preservative treatment and the sapwood is "moderately resistant" or class 2 in EN350: Part2.

Stress grades

<table>
<thead>
<tr>
<th>GS = C16</th>
<th>SS = C24</th>
</tr>
</thead>
</table>

Visual grades (BS4978)

*when subjected to relative humidity changes from 90% to 60%

Larch is one of the heavier Welsh softwoods. Three species of British grown larch are commonly used and the average density for all three is 570 Kg/m³ (BS5268: Part 2 Annex A). When well grown the timber is straight grained and free from knots. However, the majority of the timber will have small knots present. The heartwood is pale red to brown. The sapwood is usually clearly distinct and paler in colour. The heartwood may be resinous. Unlike Douglas fir that bleeds resin, larch releases resin in fine beads over the whole surface. The annual growth rings are clearly defined with the late-wood being darker than the earlywood. With the exception of yew, larch is the hardest and toughest UK grown softwoods. The timber dries reasonably quickly. The timber is acidic and this can accelerate the rate of corrosion of unprotected ferrous metals.

The timber works well with both hand and power tools, giving a good finish. The knots sometimes loosen on drying and that can damage the cutting edges of tools. It is has a slightly greater blunting effect on tools than joinery grade pine. It takes a stain and varnish satisfactorily.
Western red cedar

<table>
<thead>
<tr>
<th>Grain pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western red cedar</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dimensional movement (%)</th>
<th>Shrinkage (green to 12%)</th>
<th>tangential</th>
<th>2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>(based on UK grown material)</td>
<td>radial</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Moisture content</td>
<td>90%</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td></td>
<td>60%</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Movement* “small”</td>
<td>tangential</td>
<td>1.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>radial</td>
<td>0.8</td>
<td></td>
</tr>
</tbody>
</table>

Natural durability

- The timber is classified as "moderately durable" or class 3 in EN350: Part 1. The heartwood is classified "resistant" or class 3 to preservative treatment and the sapwood is "resistant" or class 3 in EN350: Part2+.

Strength grading

- Stress grades
- Visual grades (BS4978)
- Currently no strength data for UK grown material exists

*when subjected to relative humidity changes from 90% to 60% +BRE looked at the durability of Welsh grown western red cedar when examining its application in cladding of the St Asaph Office development. There it was found that although the material held the class 2, it was slightly more variable than the North American material.

This wood is light and soft, with a typical density at around 370 kg/m³ (at 12% moisture content). Recent tests undertaken at BRE suggest 330 kg/m³ may be more likely. The timber has a pink to red-brown colour that quickly darkens to a russet-brown. Western red cedar is non-resinous with a straight grain and coarse texture with prominent growth ring figure. The timber dries quickly in the smaller sections but in large sections the moisture may prove more difficult to extract. Especially in the UK material, this can lead to collapse.

The lightness of the timber is reflected in its strength properties which tend to be rather low, being around 20-30% lower in bending strength than Scots pine. The softness of the wood makes it prone to marking and indentation which includes bruising by chips whilst machining. Recent work at BRE has found that Welsh grown material tends to be slightly knottier than North American supplies.

Western red cedar is aggressive to un-protected ferrous metals due to its acidity. Where damp Western red cedar has come into contact with ferrous material black stains can develop. Therefore connections should be either fully galvanised, stainless steel or non-ferrous metal.

The wood can be worked easily with hand tools with little blunting effect when cutting edges. The brittleness of the timber makes it prone to splintering when working the end grain. The small knots present in UK grown material can make the timber more prone to tear out of the grain when planing.
Temperate hardwoods

Oak (Quercus sp.)

Grain patterns and colours

<table>
<thead>
<tr>
<th>Dimensional movement (%)</th>
<th>Shrinkage (green to 12%)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>tangential</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td>radial</td>
<td>4</td>
</tr>
<tr>
<td>Moisture content</td>
<td>90%</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>60%</td>
<td>12</td>
</tr>
<tr>
<td>Movement* “medium”</td>
<td>tangential</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>radial</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Natural durability
The timber has been reclassified as "durable" or class 2 in EN350: Part 1. The heartwood is classified "extremely resistant" or class 4 to preservative treatment and the sapwood is "permeable" or class 1 in EN350: Part 2.

Strength grading
There are no machine grades for hardwoods

| Visual grades (BS5756)+ | TH1 = D30 | THA=D40 |

* when subjected to relative humidity changes from 90% to 60%  
+ TH2 and THB do not meet the requirements of any of the D strength classes and so only grade stresses are available for these grades

Oak is amongst the densest of commercial UK grown timbers, an average density for structural material is around 700 kg/m³. The colour of the heartwood when freshly cut is a light caramel-brown, darkening on oxidation and exposure to light. The sapwood is a distinct creamy, yellow colour easily distinguishable from the heartwood. There are two principal species of UK grown oak: Quercus robur and Quercus petraea (pedunculate and sessile). There is little difference in performance between the species and therefore they are treated as one type of timber. The grain is mostly straight and depends on growing conditions. The texture is moderately coarse. The latewood vessels can leave an open texture to a planed surface. These large vessels can make surface treatment for exposed timber more difficult. Faster grown trees supply better quality timber. Slow grown timber has a predominance of large thin walled vessels. These tend to brash in failure and are lighter in weight.

The large, medullary rays are often most apparent in quarter sawn timber. This makes oak one of the most highly prized timbers for decorative and cabinet work. The ray can offer a failure line and can be considered a weakness as the timber will split easily along the thin walled cells. The timber is aggressive to unprotected ferrous metals due to its acidity and all connections should be galvanised, stainless steel or non-ferrous metal. In damp oak good air flow needs to be ensured through design.

Green timber is liable to rupture on the compression face. Oak dries slowly with a tendency to split and check. There is a danger of honeycombing when kiln dried and distortion may occur. Drying should be carried out slowly due to the high stresses generated while the timber sets. The working properties vary with density. It is rated as moderately blunting to cutting tools and generally planes well. The irregular cross grain can be difficult to work and a reduced cutter angle of 20° is recommended. The pre-drilling of timber is recommended to avoid splitting.
Ash (Fraxinus excelsior)

Grain pattern and colour

<table>
<thead>
<tr>
<th>Dimensional movement (%)</th>
<th>Shrinkage (green to 12%)</th>
<th>Moisture content</th>
<th>Movement* “medium”</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>tangential</td>
<td>90%</td>
<td>tangential</td>
</tr>
<tr>
<td></td>
<td>radial</td>
<td>60%</td>
<td>radial</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>22</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>4.5</td>
<td>13</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Natural durability
The timber is classified as "not durable" or class in EN350: Part 1. The heartwood is classified "moderately resistant" or class 2 to preservative treatment and the sapwood is “moderately resistant” or class in EN350: Part 2.

Strength grading
<table>
<thead>
<tr>
<th>Stress grades</th>
<th>Visual grades (BS5756)+</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not currently used as a structural material+</td>
</tr>
</tbody>
</table>

*when subjected to relative humidity changes from 90% to 60%

When grown material contains a high proportion of porous earlywood, which reduces its density and strength. The strength of ash is usually considered similar to oak or beech. Ash is very tougher than any other timber species grown in the UK and can withstand high shock and impact loads.

The timber works well with both hand and power tools giving a good finish. The timber is good at taking a stain and varnish. It glues satisfactorily with a range of adhesive types. Ash is an excellent timber for steam bending but occasionally irregular grain or small knots are troublesome.

The density of the timber is variable and very dependant on growth conditions. It can vary between 510 to 830 kg/m³ (at 12% moisture content). Ash is characterised by its white to light brown colour. Upon cutting it temporarily turns pink. The sapwood is indistinct from the heartwood. Trees occasionally contain irregular dark brown or blackheart, which sometimes associated with decay. The grain is usually straight and contrasts between the porous early wood. The dense latewood produces a distinctive figure in plane–sawn timber or rotary cut veneer.

The growth rate of the timber influences the overall performance of the material. From experience best material is found when growth rings are of 1.6 to 6mm width. Slow grown material contains a high proportion of porous earlywood, which reduces its density and strength. The strength of ash is usually considered similar to oak or beech. Ash is very tougher than any other timber species grown in the UK and can withstand high shock and impact loads.
### Beech (fagus sylvatica)

**Grain pattern and colour**

<table>
<thead>
<tr>
<th>Dimensional movement (%)</th>
<th>Shrinkage (green to 12%)</th>
<th>Moisture content</th>
<th>Movement* “large”</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>tangential 9.5</td>
<td>90% 20</td>
<td>tangential 3.1</td>
</tr>
<tr>
<td></td>
<td>radial 4.5</td>
<td>60% 12</td>
<td>radial 1.7</td>
</tr>
</tbody>
</table>

**Natural durability**

The timber is classified as "not durable" or class 5 in EN350: Part 1. The heartwood is classified "permeable" or class 1 to preservative treatment and the sapwood is "permeable" or class 1 in EN350: Part2.

**Strength grading**

<table>
<thead>
<tr>
<th>Stress grades</th>
<th>Visual grades (BS5756)+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not currently used as a structural material+</td>
<td></td>
</tr>
</tbody>
</table>

*when subjected to relative humidity changes from 90% to 60%
+ Grade stresses were quoted in CP112: 1972

The timber is very pale brown and darkens to a red hue on exposure to light. The density of the timber depends greatly on the conditions of growth but is usually of the order of 750 kg/m³ (at 12% moisture content). Northern European and British grown timber is usually denser than central European grown timber. The heart wood is indistinct from the sapwood but some trees show a darker coloured core or “red heart”, frequently with associated dark veining. Steaming of beech, as practiced in southern Europe turns the timber pink to light red. The grain is usually straight with broad medullary rays, though these are not as large or pronounced as in oak. The timbers texture is fine and even.

Beech is one of the strongest timbers grown in the British Isles, being slightly stronger than oak, but variations in density are reflected in strength. The grain is usually interlocked which may affect the machining properties, though the wood normally works well with both hand and power tools giving a good finish. It is has a moderate blunting effect on tools and cutter edges. It takes a stain and varnish satisfactorily.
**Elm (Ulmus Sp.)**

**Grain pattern and colour**

<table>
<thead>
<tr>
<th>Dimensional movement (%)</th>
<th>Shrinkage (green to 12%)</th>
<th>Moisture content</th>
<th>Movement* “medium”</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>tangential</td>
<td>90%</td>
<td>tangential</td>
</tr>
<tr>
<td></td>
<td>radial</td>
<td>60%</td>
<td>radial</td>
</tr>
<tr>
<td></td>
<td>6.5</td>
<td>22</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td>4.5</td>
<td>13</td>
<td>1.5</td>
</tr>
</tbody>
</table>

**Natural durability**

The timber is classified as "slightly durable" or class 4 in EN350: Part 1. The heartwood is classified "resistant" or class 3 to preservative treatment and the sapwood is “permeable” or class 1 in EN350: Part 2.

**Stress grading**

<table>
<thead>
<tr>
<th>Stress grades</th>
<th>Visual grades (BS5756)+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not currently used as a structural material+</td>
<td></td>
</tr>
</tbody>
</table>

*when subjected to relative humidity changes from 90% to 60%  
+ Grade stresses were quoted in CP112: 1972

The density of Elm is of the order of 550 kg/m³ (at 12% moisture content). Both stiffness and strength are moderate. The strength performance is about 40% less than that of beech.

Elm can be quite difficult to obtain since the Dutch elm disease of the 1970’s when many millions of trees were lost. Wales, like Scotland, still has standing stocks. Providing efficient supply Elm is a timber worthy of inclusion in any building. It is a distinctive timber with a dull-brown surface when dried. The heartwood is clearly distinguished from the sapwood which is much lighter and almost cream in colour. The annual rings are distinct and wide due to large amount of early wood pores, giving the wood a coarse texture. Cross grained and irregular growth patterns are attractive in appearance, especially when polished or oiled. It is an excellent timber for vernacular furniture.

Elm dries fairly rapidly and has a tendency to distort but little tendency to split or check. There is some potential to collapse. It is rated as having moderate blunting of cutting edges but in general it works well with both hand and power tools, giving a good finish. It takes a stain and varnish satisfactorily and can be glued with a range of adhesives.
Sycamore (*Acer pseudoplatanus*)

<table>
<thead>
<tr>
<th>Grain pattern and colour</th>
<th>Shrinkage (green to 12%)</th>
<th>Moisture content</th>
<th>Movement* “medium”</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>tangential 5.5</td>
<td>90% 23</td>
<td>tangential 2.8</td>
</tr>
<tr>
<td></td>
<td>radial 2.5</td>
<td>60% 13.5</td>
<td>radial 1.4</td>
</tr>
</tbody>
</table>

**Natural durability**

The timber is classified as *not durable* or class 5 in EN350: Part 1. The heartwood is classified *permeable* or class 1 to preservative treatment and the sapwood is "permeable" or class 1 in EN350: Part 2.

**Strength grading**

<table>
<thead>
<tr>
<th>Stress grades</th>
<th>Visual grades (BS5756)+</th>
</tr>
</thead>
<tbody>
<tr>
<td>No data available</td>
<td></td>
</tr>
</tbody>
</table>

*Swhen subjected to relative humidity changes from 90% to 60%*

Sycamore is creamy to yellow white in colour with a natural lustre that is especially marked on quarter sawn material. The density of the timber is of the order of 610 kg/m³ (at 12% moisture content). The timber dries slowly in air dry conditions and turns a light brown, generally referred to as weathered sycamore. The sapwood is indistinct from the heartwood and the grain in usually straight. Wavy or curly grain, known as fiddle back, is rare and highly sought after. The texture is fine and even.

Sycamore dries well but is prone to staining and best visual quality is obtained when exercising care in handling. End stacking is frequently employed to allow the board surfaces to dry before kilning. Sycamore can be worked well with both hand and power tools. It is rated as having moderate impact of blunting of cutting edges. The material has a tendency to burn when being drilled or machined with blunt cutters. Stain and varnish can be applied to the timber and it can be glued using a range of adhesives.
Sweet chestnut (*Castanea sativa*)

**Grain pattern and colour**

<table>
<thead>
<tr>
<th>Dimensional movement (%)</th>
<th>Shrinkage</th>
<th>Moisture content</th>
<th>Movement*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>tangential</td>
<td>90%</td>
<td>tangential</td>
</tr>
<tr>
<td></td>
<td>radial</td>
<td>60%</td>
<td>radial</td>
</tr>
<tr>
<td></td>
<td>5.5</td>
<td>17.5</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>12.5</td>
<td>0.7</td>
</tr>
</tbody>
</table>

**Natural durability**

The timber is classified as "durable" or class 2 in EN350: Part 1. The heartwood is classified "extremely resistant" or class 4 to preservative treatment and the sapwood is "moderately resistant" or class 2 in EN350: Part 2.

**Stress grading**

<table>
<thead>
<tr>
<th>Strength grading</th>
<th>Stress grades</th>
<th>BS 5268:Part 2- 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual grades</td>
<td>TH1</td>
<td></td>
</tr>
</tbody>
</table>

*when subjected to relative humidity changes from 90% to 60%

Sweet chestnut heartwood is a pale, caramel colour and is not dissimilar to plane sawn oak in appearance, but without the large medullar rays. The sapwood is paler than the heartwood and can be clearly distinguished. The strength of the timber is slightly lower than both beech and oak, and the density is around 540 kg/m³ (at 12% moisture content). The grain is predominantly straight with the exception of old trees where spiral grain can be found. The moderately coarse texture with large open vessels in the early wood portion of the growth rings can be problematic, especially when paint or varnishes are applied. Ring shakes can also be a problem in older trees.

The timber has a tendency to dry slowly. The timber is aggressive to un-protected ferrous metals due to its acidity. Black stain can develop where damp timber has come in contact with ferrous metals. The timber is rated as having moderate blunting of cutting edges but in general it works well with both hand and power tools. Sweet chestnut has a good finish. It takes a stain and varnish satisfactorily and can be glued with a range of adhesives. It has good wood bending properties for steam bending.
Timber acidity
Some of the commercially important timbers produced within Wales are acidic. Whilst this has generally no influence on the structural or mechanical properties of the material, it needs to be considered with regard to mechanical fixings and contact with ferrous metal in general. The acidity of oak, sweet chestnut, larch, Douglas fir and western red cedar can lead to enhanced corrosion of unprotected ferrous metal fixings. This can significantly reduce the service life of the fixings. Therefore all metal fixings used with these species should be either hot-dipped galvanised steel, stainless steel or non-ferrous metals, such as copper.

When damp timber and ferrous metals are in contact an blue / black stain can result. A slight staining can be expected even with the use of hot-dipped galvanised, stainless or non-ferrous fixings. This is to be considered when using timber in external applications. Localised stains can be removed with oxalic acid. However, oxalic acid is a metabolic iron inhibitor and should be used with care and sparingly. Therefore it is generally better to prevent the occurrence of stain rather than to remove it once formed.

Moisture content and the timber resource
It will be seen from the individual descriptions of the timber species that great emphasis has been placed on the moisture content of timbers and the dynamic response in reaction to changes in moisture content brought about by changes in the humidity of the environment. This is described as the Equilibrium Moisture Content (EMC), an important feature of timber, which is in a constant interplay with atmospheric moisture conditions. Provided that timber has been correctly conditioned and the environment is stable, the dimensional changes are small and insignificant. However, higher moisture content timber placed in a heated or dry atmosphere will result in uncontrolled dimensional changes. Correct specification of moisture content for all timber components is essential.

In certain circumstances tighter controls on moisture content might be advisable. Within the timber frame elements moisture content specification of the framing timbers will be critical to minimise dimensional movement. This is particularly important in multi-storey structures where the movement accumulates and can impact on installation of lifts and similar fixed plants such as pipe work or cabling. Here the movement between the timber-frame and fixed plant is best reduced to a minimum.

The moisture content of external timber will be more difficult to specify as the changes in environmental, seasonal conditions are far more extreme. This may become increasingly important as climate change appears to be driving hotter summers and wetter winters. Building and orientation of external timber to prevailing weather are main influencing factors. Timber oriented to the south or south-west will show the greatest changes in EMC and timber with a north or north-east orientation will only have a moderate EMC response. For most timbers surface treatments such as paints or stains can be used to help control the interplay with the external environment. However, for external cladding species like western red cedar and sweet chestnut can be demonstrated to show fewer effects of repeated changes in the EMC and therefore can be left untreated with careful design.

Poor site practice can jeopardise the moisture controlled timber, where the timber supply chain has been brought together to deliver timber to site at an acceptable and agreed moisture content. Timber components being left on site exposed to the weather will undo all the good work and co-operation between timber supplier and timber processor. Therefore site practices will need to show best practice in ensuring the timber delivered to site is stored correctly.
Durability

The first obvious way of ensuring durability is to select naturally durable species with the appropriate properties for the end use application. This should be done in accordance with EN355, EN350 and EN460. As can be seen from the description of the timbers available within Wales, many do not have a high degree of natural durability. Only Oak, Larch and western red cedar show natural durability suitable for external use in considered applications. For the majority of timbers and applications, durability needs to be controlled. If there is a need to meet the highest environmental standards the use of chemical preservatives may be discouraged, if so other methods will need to be sought. Generally products, such as Tanalith E should not be totally excluded from the design process as they can offer suitable protection and are available within Wales. The careful specification of preservatives is of paramount importance and expert advice should be sought to ensure optimum treatment choice. Alternatives to chemical preservative treatments exist. These alternative methods modify the timber structure and include:

- Heat treated timber
- Hot oil treatments
- Acetylation

These processes are being increasingly used, especially in continental Europe, but may at this stage be regarded as experimental, particularly when used in the UK climate. At this time there are no UK based commercial production facilities and timber material would need to be treated abroad.

Alternative, passive approaches to durability are well established. These solutions maintain the timbers’ EMC below threshold level for decay, nominally around 20%. This can be achieved by

- Defensive design of exposed, decay prone timbers
- Correct detail specification
- Surface treatments and end grain sealing

Some illustrative examples for each approach are given below. Defensive design features for vulnerable timber element include:

- Sheltering, large roof overhangs
- Using porches to protect entrances
- Setback windows and doors
- Placing timber components away from direct wetting paths
- Designing and maintaining effective rain water disposal systems
- Preventing spillage onto the building fabric.

Correct detailing would include such items as:

- Ensuring joint details function to exclude water, shedding water before it can penetrate the timber
- Ensuring good ventilation around the timber components, so that wet timber can dry out rapidly
- Effective sealing and skimming of joints and fixing holes to avoid water entering the timber member
- Avoid splashing of rainwater against vertical timber members. Use of splash dissipaters at ground level, such as gravel beds.

Obviously surface treatments (paint, stain systems) correctly specified and applied will help control the EMC and maintain exposed timber members below the risk threshold. However, once applied paint and stain systems will need regular maintenance to give acceptable performance. End grain sealing is a simple but effective method of controlling ingress of moisture into the end grain of timber, which is a frequent point of early on set of decay.
**External exposure of natural finished timber**

The use of natural finished timber is a growing trend, driven by two different requirements:

- The belief that the natural finish is an environmental friendly approach to construction reducing the use of applied chemicals.
- The desire by the end user that a natural finish will reduce or eliminate the need for maintenance and so reduce overall running costs.

When choosing to leave timber untreated the following consequences need to be considered. The first and most obvious consequence will be a greying of the timber surface. The natural colour of the timber will disappear in time. The greying process will continue until a uniform colour is achieved. This will happen with greater rapidity on a south and south western aspect due to the effects of the sun. With time surface checking will develop due to over drying of the surface in the summer, these will close in the winter when seasonal wetting will be more prevalent but once in the timber the checks will remain and develop with time. Furthermore water staining of the surface of the timber may become prominent, as a mottled effect in some species due to extractive migration within the timber. The surface of the timber will have a tendency to maintain a higher EMC than a treated timber surface, particularly at joints, and this can lead to early onset of decay. It is also possible that the surface fibres of the timber will lift, giving a slightly woolly appearance. It has been observed in the past that these surface fibres are grazed by wasps for nest material, which can leave patches of lighter coloured material, giving a patchy appearance to the timbers surface.

The growth of a green algal bloom may develop on north facing cladding where the drying effect of the sun has least effect. This is generally not be detrimental to the cladding but may be considered to be unsightly. However, pressure washing will help control this. However, premature replacement of timber will normally be related to aesthetics, rather than a technical failure of the timber.

The client should seek expert advice on the weathering properties of the exposed timber at the design stage. Visual appearance in the weathered condition needs to be the basis for any decision and clients should be advised to use appropriate surface treatments to ensure the intended visual appearance in the long-term, also considering necessary regular maintenance requirements.
Structural Timber

Structural timber undergoes an evaluation process against a set of parameters. This process attributes working stresses, strength and moduli for use in structural design calculations. Timber strength grading in the UK is overseen by the United Kingdom Timber Grading Committee (UKTGC) and is carried out under third party certification. All companies that strength grade timber must register with a third party certification body that will oversee training of timber graders and functioning of strength grading machines.

All structural timber in the UK should be stamped with a mark, stating the:

- The strength class of the timber
- The species or species mix
- The producing company identification number or the visual graders number
- The certification body’s logo
- The moisture condition. It should be remembered that “dry” structural timber has a moisture content of about 20%. This may not be sufficient for application in medium- to high-rise construction and negotiations will need to take place between the sawmillers and the timber framers to agree a reduction in this moisture content.

Timber can be strength graded in two ways, either visually or machine graded. Visual grading is carried out against the requirements of BS4978 for softwoods and BS5756 for hardwoods. The visual grades can be attributed to a strength class or grade stress and these can be found in BS5268: Part 2- 2002.

Softwoods can be machine graded against the requirements of BS 519, however, this may change in the near future as there is planned harmonisation of the European structural timber codes and strength grading of timber will fall under prEN 14080: Parts 1 to 4. The timber is attributed directly to a strength class and these strength classes are set out in BS5268: Part 2 - 2002.

Strength classes and grade stresses

It is now common to refer to structural timber with regard to a strength class where as in the past the grade stresses were more common. A strength class, like a grade stress is a collection of stresses and moduli that clearly describe the structural capability of the timber. This allows every structural engineer to safely design with timber, without particular, in-depth knowledge in timber design and the various timber species.

When using the strength class approach, the timber species is Sitka spruce, larch, Douglas fir or European whitewood is only of secondary importance, as the designer will use a strength class stress in calculations, for example C16. Their main draw back is that the stresses and moduli for the strength class are minimum targets that must be met by a timber species to be included. In reality not all the measured parameters fit neatly in to a strength class. Certain species may only just make the strength class on strength but may exceed the requirements for stiffness or density. This stiffness or density above the stated minimum for the strength class can not be used in calculations for structural performance, and so that species capacity is underestimated in design.

Grade stresses are, like strength classes, sets of stresses and moduli but are specific to the particular timber species. They are characteristic values by which a species can be assessed for a strength class. Their great merit is that they far better describe the structural properties of the individual species. However, the engineer has to know before commencement of the design which timber species they wish to use.
Standard sizes for structural timber
There are standard target sizes for structural timber for both sawn and planed conditions; these are set down in BS EN336. However, for visually graded material almost any size can be graded with a lower limit of 20mm thickness but no upper limit. For machine graded timber there is a large array of machine settings available to grade against and these should satisfy most requirements. The size of timber that can be graded ranges for a minimum of 35mm to a maximum 75mm wide and a minimum depth of 60mm to a maximum of 300mm depth.

Timber framing usually has timber sizes specified to standard CLS sizes for the stud work. The use of CLS is somewhat misleading; in fact CLS relates to “Canadian Lumber Standard” and bears little relation to UK strength graded timber. The term has become appropriate to describe timber that has 3mm rounded array and the timber framers will have to liaise with the timber frames to ensure prosecution of such timber can be achieved to the required tolerances.

Truss rafter roofs
It is more than probable that the structural elements of the roof, if made in timber, will be truss rafter configurations. The most frequently used timber in truss rafter construction is European whitewood as it easily meets the TR26 strength requirement. This strength class is extensively used and all the commercial truss rafter manufactures use software packages to design with the strength class. Therefore, the possibility of producing truss rafters is limited, although not restricted to this grade. Whilst most commercial manufactures use European whitewood because this species yields high volumes of TR26 in line with the software package requirements, there is no technical reason why other strength classes can not be used. However, without the sophisticated design packages the design process would be laborious when considering the likely complexity of such a roof.

Welsh structural timber
As can be seen from the description of the Welsh timbers many have been assessed for structural purposes and have been fully tested deriving stresses and ensure compliance with visual grades and machine settings. Most of them are attributed to a strength class. Therefore, there should be no difficulty in finding material for most of the structural applications.

There may be the instance where certain timbers are chosen for use in a structural application but at present do not have structural stresses to facilitate their use. This should not be considered a major difficulty, as stresses can be economically derived where the population of timber to be used is known and the application of the structural stresses are for a single building project.

Glulam
Glulam is preferably used in applications where the spans in question are greater than can be achieved safely with solid timber. Glulam is a strong alternative to steel beams. Glulam cannot only be used to achieve large spans but also to visually enhance the appearance of the exposed structural elements of the building. Although Glulam has yet to be used on a wider scale in the UK it is very common in Germany and Austria. Most of the volumes of Glulam used are made from European whitewood. Home grown material is not at all excluded from consideration.
Glulam can be designed using either BS5268: Part 2 where the strength of the timber chosen based on a strength class is factored by the number of laminated that make up the beam to derive the permissible bending strength. Alternatively Glulam can be designed by EN1194 based on tension strength and tension stiffness. EN 1194 allows more flexibility in design and consequently can allow for both homogeneous and heterogeneous beams to be designed.

Homogeneous beams are made from one strength class of timber and usually one species and are the most frequently designed type of beam. A Glulam beam made from C24 UK grown larch is shown below. Heterogeneous beams are made from more than one strength class of timber. The arrangement is such that the higher strength class used is arranged on the compression and tension faces of the beams and the lower strength class material is placed at the centre of the beam. Whilst there is little difference in strength between homogeneous and heterogeneous beams having the same strength class on the out laminations stiffness for heterogeneous beams is usually determined by the lower strength class material and will, therefore, be lower than for the heterogeneous beams. Therefore heterogeneous beams will need to be deeper to meet the same serviceability requirements.

Both the new parliamentary buildings in London, Portcullis House, and the Scottish Parliamentary building in Edinburgh, Holyrood House, used oak Glulam beams. However, in both cases the beam was not made for UK grown timber. In the case of Portcullis house the timber was American white oak and for Holyrood House the timber was French oak. Provided that Welsh oak can be supplied at suitable moisture contents there would be sufficient strength class data to allow Glulam design with Welsh timber.

It is also possible to use Glulam, based on test data. This overcomes situations where the full structural properties of the timbers are not known but sufficient data exists for assumptions to be made. The performances of the beam can then the tested to demonstrate fitness for purpose. BRE has extensive expertise in this area of work, having undertaken work on sweet chestnut beams made from coppiced timber for example, enabling their use by establishing performance levels in a 24 hour loading test.

The manufacture of Glulam from Welsh timber, particularly for very long spans may need to be sourced from outside Wales, but manufactures do exist within the UK with firms like Kingston Craftsman’s (Hull) capable of long span glulam or Inwood Developments (Sussex) that can produce Glulam of 6 to 7 metres and specialise in coppice material.
Wood based panel products

Many components of a modern building comprise wood based panel products in one form or another, the common examples are given below:

- Particleboard
- Medium density fibreboard (MDF)
- Plywood
- Orientated strand board (OSB)

Wood based panel products are very common in modern construction, particularly in timber frame where the sheathing, of usually OSB, adds to the racking resistance of the studded frame. It would be feasible and logical to use producers from within Wales.

There is one manufacture of wood based panel products within Wales - Kronospan based at Chirk, North Wales and their production includes:

- MDF
- OSB
- Particleboard

It is not known how much local material is used in these boards. However, being located in North Wales it seems more than likely that some of the High Forest category 2 materials are a vital feed stock in this production.

To locate other suppliers of wood based panel products the search would need to be extended outside Wales and still the options are limited to:

- Scotland with one plant producing OSB and MDF
- Ireland with production of OSB and MDF
- England with one plant producing particleboard

Sadly there are no producers of plywood within the UK and in consequence Europe and particularly Northern Europe would be the most appropriate option.

Non-structural timber

‘Green’ Gluing

A large quantity of the Welsh timber resource, especially the hardwood resource is of low quality, coming from small poorly shaped trees, coppice material or thinnings. Even so, this material is an important renewable resource and its economic potential can be maximised by utilising as much of this material as possible for higher value markets. The green gluing and re-engineering of timber using finger-jointing and laminating techniques will greatly assist in achieving this goal.
High value markets require longer, larger or clearer sections of timber. These can be attained through re-engineering by finger-jointing and laminating. Finger-jointing enables short lengths of clear timber to be bonded together to produce continuous lengths of high quality material which can subsequently be cross-cut to the required dimensions. This process is most effectively done whilst the timber is green. Laminating involves the gluing together of two or more lengths of timber to build up a larger cross section from smaller pieces. Most laminate bonding is carried out after the timber has been dried, although it is possible to bond two laminates in the wet state without problems.

Timber product manufacturers across the USA and Europe currently use finger-jointed and laminated timber in their manufacturing processes. In many parts of Europe they are used extensively to produce large structural beams (glulam). All these bonding processes are undertaken using dry timber (below 15% moisture content).

‘Green’ gluing differs from the conventional method of gluing described above primarily because of the moisture content of the timber. ‘Green’ gluing is undertaken directly after primary processing when the timber has a high moisture content (moisture contents between 18% and 200%) in the ‘green’ state. Drying is carried out after bonding has been undertaken.

Re-engineering the timber whilst it is ‘green’ has a number of advantages over dry gluing. These include: increased timber utilisation, increased dimensional stability, energy and space savings, reduced distortion and improved workability.

The diminishing quality of timber in the whole of Europe, including the UK, places an increasing importance on making better use of all available resources. Low grade logs form a significant proportion of woodland harvests and are being sold for chipping, pulp or firewood at very low prices. As a result, woodland managers often fail to cover their harvesting and processing costs and many types of woodland are undermanaged or maintained at a loss. It has been demonstrated that green and dry gluing can be undertaken on many timber species, both hardwoods and softwoods.

The following section describes the technical aspects of the green gluing process; methods used to add value to low grade timber.

**Adding value to low grade timber**

**Finger-jointing (and defect cutting)**

Several stages are involved in the finger jointing process: identification of unwanted defects, removal of defects, cutting of fingers, application of adhesive and assembly of clear lengths into long continuous battens of the desired length. The following diagrams show the key steps; a board containing defects, defect removal and the resultant finger jointed board without defects. Un-wanted defects are marked for removal and then removed as shown. Finger-joints are machined in each end of the defect free, clear lengths. The adhesive applied and the pieces are joined together under pressure. The defect free lengths have improved structural integrity, reduced tendency to distort during drying and greater aesthetic appeal.
**Joint type**

Two main types of finger joint are available, horizontal or vertical. The type of joint used depends upon the final use of the material.

<table>
<thead>
<tr>
<th>Joint Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Horizontal finger joint</strong></td>
<td><em>Horizontal joints</em> are mainly used in products where the final appearance of the wood surface only shows a straight line or butt joint where a finger joint occurs, for example, in flooring or furniture. This joint is slightly weaker than a vertical finger joint due to the flat sections on the upper and lower faces of the timber.</td>
</tr>
<tr>
<td><strong>Vertical finger joint</strong></td>
<td><em>Vertical joints</em> are commonly used for construction applications and instances where a continuation of the grain is required and the zigzag profile is not a problem.</td>
</tr>
</tbody>
</table>
Laminating – Face and Edge

Face and edge laminating can be used where larger dimension timbers are required. It is possible to build up the cross section of a re-engineered batten to virtually any dimension using this technique. Planed or clean sawn battens can be used for this process, although planed surfaces will provide a stronger joint and use less adhesive. The adhesive is applied to the faces or edges of prepared material and the battens pressed under pressure. It should be noted that in the green state, face laminating with more than 3 laminations, may lead to difficulties during kiln drying.

It is recommended that drying should be undertaken before making laminated sections out of 4 or more laminates. It is also recommended that edge laminating be carried out in the dry state unless there sufficient knowledge of timber drying. Face and edge laminated boards are shown above.

Adhesives

There are two main types of adhesive used in green gluing:

- The Greenweld™ system initially developed and patented by the New Zealand Forest Research Institute (NZFRI), is a two pack resorcinol based adhesive with a volatile accelerator. This system cures quickly and has gap filling properties. The adhesive is brown in colour and the glue line is clearly visible on light coloured timber.

- Collano Purbond is a polyurethane (PU) based adhesive. This is a one pack system that can be purchased with several curing times (30 minutes, 1 hour and 2 hours). To work efficiently, bonding faces must be close fitting. The adhesive is virtually colourless when dry.

Both of these adhesive systems have been assessed by BRE and found to work effectively on virtually all wet timber species. The PU based adhesive can be almost invisible when the jointed wood components are end-matched to give an appearance of continuous natural grain. For this reason, the PU adhesive is
the most appropriate system for joinery products and has been used in the demonstration products constructed in this study. The figure below shows the appearance of the two adhesive systems when used for finger jointing.

Finger joints showing the two adhesive systems. The Polyurethane system was used to joint the upper batten and the Greenweld™ system the lower batten.

Green glued products

Structural timber products can be produced successfully using green gluing technology. As there are no current standards for the jointing of wet timber for structural use, the introduction of structural green glued products to the market place requires third party accreditation to demonstrate the performance of the product and ensure it is fit for purpose. Almost any dimension of timber can be produced using green gluing. Potential joinery products include window frames, work tops, external gates, flooring and joinery blanks.
# OVERVIEW TIMBER RELATED BUSINESSES IN WALES

## Roundwood

### Hardwood

<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>AOM &amp; Associates</td>
<td>Carmarthenshire</td>
</tr>
<tr>
<td>Arborcraft</td>
<td>Cardiff</td>
</tr>
<tr>
<td>Daftydd Cadwolaicr</td>
<td>Gwynedd</td>
</tr>
<tr>
<td>Cynnyion Timber</td>
<td>Shropshire</td>
</tr>
<tr>
<td>B W Dodd &amp; Son</td>
<td>Powys</td>
</tr>
<tr>
<td>Gower Woodland &amp; Charcoal</td>
<td>Swansea</td>
</tr>
<tr>
<td>Mick Jones Timber</td>
<td>Powys</td>
</tr>
<tr>
<td>Leighton Estate</td>
<td>Powys</td>
</tr>
<tr>
<td>Melingood Ltd</td>
<td>Carmarthenshire</td>
</tr>
<tr>
<td>Mostyn Estate Sawmill</td>
<td>Flintshire</td>
</tr>
<tr>
<td>Roger Payne</td>
<td>Wrexham</td>
</tr>
<tr>
<td>Pontypool Park Estate</td>
<td>Torfaen</td>
</tr>
<tr>
<td>Powys Castle Estate Oak, Sycamore, Ash</td>
<td>Powys</td>
</tr>
<tr>
<td>William Roberts &amp; Co. Ltd</td>
<td>Anglesey</td>
</tr>
<tr>
<td>William Roberts &amp; Co. Ltd</td>
<td>Gwynedd</td>
</tr>
<tr>
<td>Robins Timber Contracting</td>
<td>Carmarthenshire</td>
</tr>
<tr>
<td>Allan Rowlands Timber</td>
<td>Shropshire</td>
</tr>
<tr>
<td>Smallwood Services Beech, Oak, all sizes</td>
<td>Powys</td>
</tr>
<tr>
<td>Talarris Park Woodlands</td>
<td>Carmarthenshire</td>
</tr>
<tr>
<td>Woodland Turnery</td>
<td>Torfaen</td>
</tr>
<tr>
<td>Ystrad Estate</td>
<td>Powys</td>
</tr>
</tbody>
</table>

### Softwood

<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>AOM &amp; Associates</td>
<td>Carmarthenshire</td>
</tr>
<tr>
<td>Arborcraft</td>
<td>Cardiff</td>
</tr>
<tr>
<td>Davies Forestry Contractor</td>
<td>Powys</td>
</tr>
<tr>
<td>B W Dodd &amp; Son</td>
<td>Powys</td>
</tr>
<tr>
<td>Cwm Oergwm Woodland Maintly Douglas Fir and Japanese larch</td>
<td>Powys</td>
</tr>
<tr>
<td>Cynnyion Timber</td>
<td>Shropshire</td>
</tr>
<tr>
<td>Davies Forestry Contractor</td>
<td>Powys</td>
</tr>
<tr>
<td>Glaslyn Fencing and Sawmill</td>
<td>Gwynedd</td>
</tr>
<tr>
<td>Clifford Jones Timber Ltd</td>
<td>Denbighshire</td>
</tr>
<tr>
<td>Leighton Estate Douglas Fir, Larch</td>
<td>Powys</td>
</tr>
<tr>
<td>Melingood Ltd</td>
<td>Carmarthenshire</td>
</tr>
<tr>
<td>Mostyn Estate Sawmill</td>
<td>Flintshire</td>
</tr>
<tr>
<td>Pontypool Park Estate</td>
<td>Torfaen</td>
</tr>
<tr>
<td>Powys Castle Estate Douglas Fir</td>
<td>Powys</td>
</tr>
<tr>
<td>Red Rock Forestry</td>
<td>Gwynedd</td>
</tr>
<tr>
<td>William Roberts &amp; Co. Ltd</td>
<td>Anglesey</td>
</tr>
<tr>
<td>William Roberts &amp; Co. Ltd</td>
<td>Gwynedd</td>
</tr>
<tr>
<td>Robins Timber Contracting</td>
<td>Carmarthenshire</td>
</tr>
<tr>
<td>Allan Rowlands Timber</td>
<td>Shropshire</td>
</tr>
<tr>
<td>Smallwood Services Larch, Spruce</td>
<td>Powys</td>
</tr>
<tr>
<td>Talarris Park Woodlands</td>
<td>Carmarthenshire</td>
</tr>
<tr>
<td>Telli Timber Products Ltd.</td>
<td>Powys</td>
</tr>
<tr>
<td>Ystrad Estate</td>
<td>Powys</td>
</tr>
</tbody>
</table>
Sawn timber

Hardwood

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGM &amp; Associates</td>
<td>Carmarthenshire</td>
</tr>
<tr>
<td>Dried hardwood</td>
<td></td>
</tr>
<tr>
<td>Up to 6ft dia and 50ft length</td>
<td></td>
</tr>
<tr>
<td>C &amp; G Barrett</td>
<td>Monmouthshire</td>
</tr>
<tr>
<td>Benson Woodworking</td>
<td>Powys</td>
</tr>
<tr>
<td>Boys &amp; Boden Ltd</td>
<td>Powys</td>
</tr>
<tr>
<td>Dafydd Cadwaladr</td>
<td>Gwynedd</td>
</tr>
<tr>
<td>Capel Iago Sawmills</td>
<td>Carmarthenshire</td>
</tr>
<tr>
<td>Cefnllwyn Timber</td>
<td>Ceredigion</td>
</tr>
<tr>
<td>Gelli Buarth Oak boards 1&quot; &amp; 2&quot; max</td>
<td>Carmarthenshire</td>
</tr>
<tr>
<td>Coed y Squire Timber</td>
<td>Cardiff</td>
</tr>
<tr>
<td>Gyninon Timber</td>
<td>Shropshire</td>
</tr>
<tr>
<td>Dickman Sawmills</td>
<td>Carmarthenshire</td>
</tr>
<tr>
<td>Welsh &amp; some tropical sawn timber, fresh sawn &amp; air dried</td>
<td></td>
</tr>
<tr>
<td>Edistone Woods</td>
<td>Powys</td>
</tr>
<tr>
<td>Ewvo Wood</td>
<td>Conwy</td>
</tr>
<tr>
<td>G &amp; T Evans</td>
<td>Powys</td>
</tr>
<tr>
<td>All sizes of Oak, Ash, Beech, treated or untreated</td>
<td></td>
</tr>
<tr>
<td>M D Evans</td>
<td>Ceredigion</td>
</tr>
<tr>
<td>Jonathan Guest Furniture Maker Klin dried Hardwood</td>
<td>Pembrokeshire</td>
</tr>
<tr>
<td>Gower Woodland &amp; Charcoal</td>
<td>Swansea</td>
</tr>
<tr>
<td>Heartwood Dried Hardwood</td>
<td>Powys</td>
</tr>
<tr>
<td>Clifford Jones Timber Ltd</td>
<td>Denbighshire</td>
</tr>
<tr>
<td>Mick Jones Timber</td>
<td>Powys</td>
</tr>
<tr>
<td>Air &amp; kiln dried</td>
<td>Powys</td>
</tr>
<tr>
<td>Leighton Estate Ash</td>
<td>Powys</td>
</tr>
<tr>
<td>D Lloyd &amp; Sons</td>
<td>Carmarthenshire</td>
</tr>
<tr>
<td>Llwyn Timber Product Welsh Oak, Ash, Sycamore &amp; Beech, green or kiln dried</td>
<td>Gwynedd</td>
</tr>
</tbody>
</table>

Hardwood

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mellingoed Ltd</td>
<td>Powys</td>
</tr>
<tr>
<td>Andrew Milward Joinery</td>
<td>Pembrokeshire</td>
</tr>
<tr>
<td>Mynydd Estate Sawmill Oak (specialising in beams &amp; finials), Sycamore, Chestnut, &amp; Cherry</td>
<td>Flintshire</td>
</tr>
<tr>
<td>All timber sawn to requirements</td>
<td>Powys</td>
</tr>
<tr>
<td>Oakden Timber</td>
<td>Powys</td>
</tr>
<tr>
<td>Green, air dried &amp; kiln dried</td>
<td>Powys</td>
</tr>
<tr>
<td>Roger Payne</td>
<td>Wrexham</td>
</tr>
<tr>
<td>Up to 5 meter lengths and 1 meter widths</td>
<td>Powys</td>
</tr>
<tr>
<td>Powis Castle Estate Air &amp; kiln dried Oak and other hardwoods</td>
<td>Powys</td>
</tr>
<tr>
<td>Rodgeway Timber</td>
<td>Pembrokeshire</td>
</tr>
<tr>
<td>Up to 3ft dia and 21ft length</td>
<td>Anglesey</td>
</tr>
<tr>
<td>William Roberts &amp; Co. Ltd</td>
<td>Gwynedd</td>
</tr>
<tr>
<td>William Roberts &amp; Co. Ltd</td>
<td>Herefordshire</td>
</tr>
<tr>
<td>Teme Timber</td>
<td>Powys</td>
</tr>
<tr>
<td>Timberwise</td>
<td>Swansea</td>
</tr>
<tr>
<td>A Williams</td>
<td>Torfaen</td>
</tr>
<tr>
<td>Large quantities of Oak, Kiln dried Wavy Edged &amp; Square edged 1&quot; - 4&quot; Air dried 5&quot; - 5' Beams up to 50ft +</td>
<td>Shropshire</td>
</tr>
<tr>
<td>Woodland Turnery</td>
<td>Torfaen</td>
</tr>
<tr>
<td>Woodlink Forest Products Ltd</td>
<td>Shropshire</td>
</tr>
</tbody>
</table>
### Softwood

<table>
<thead>
<tr>
<th>Softwood</th>
<th>Carmarthenshire</th>
<th>Ceredigion</th>
<th>Cardiff</th>
<th>Shropshire</th>
<th>Powys</th>
<th>Powys</th>
<th>Powys</th>
<th>Powys</th>
</tr>
</thead>
<tbody>
<tr>
<td>AOM &amp; Associates</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dried softwood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Up to 68 4.75 and 50 ft length</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C &amp; G Barrett</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Douglas Fir</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benson Woodworking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys &amp; Boden Ltd</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BSW Timber PLC trade only</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dried softwood, processing lengths from 2.4-4.8 metres</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BSW Timber PLC trade only</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Processing lengths from 1.6-3.6 metre</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capel Iago Sawmills</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dried softwood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefnllwyn Timber</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coed y Squire Timber</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cynrний Timmer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dickman Sawmills</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Welsh &amp; some tropical sawn timber, fresh sawn &amp; air dried</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Edistone Woods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elwy Wood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G&amp;T Evans</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All sizes of Douglas Fir, Larch, Spruce treated or untreated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M D Evans</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gladyn Fencing and Sawmill</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dried softwood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heartwood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clifford Jones Timber Ltd</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leighton Estate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Douglas Fir, Larch</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Llewellyn Product</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durable softwood Cedar, Douglas Fir &amp; Larch for shed making, cladding etc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log-Craft</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Western Red Cedar, Larch &amp; Douglas Fir</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mellingoed Ltd</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Powys</td>
<td>Powys</td>
</tr>
<tr>
<td>Mosopin Estate Sawmill</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
</tr>
<tr>
<td>Larch, Pine, &amp; Spruce – board or beam</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
</tr>
<tr>
<td>Ridgeway Timber</td>
<td></td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
</tr>
<tr>
<td>Up to 35 ft dia and 21 ft length</td>
<td></td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
</tr>
<tr>
<td>William Roberts &amp; Co. Ltd</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
</tr>
<tr>
<td>William Roberts &amp; Co. Ltd</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
</tr>
<tr>
<td>Teifi Timber Products Ltd</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
</tr>
<tr>
<td>Dried softwood</td>
<td></td>
<td></td>
<td></td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
</tr>
<tr>
<td>Timeware</td>
<td></td>
<td></td>
<td></td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
</tr>
<tr>
<td>Edward Thomas &amp; Son Ltd</td>
<td></td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
</tr>
<tr>
<td>Spruce only</td>
<td></td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
</tr>
<tr>
<td>Woodlink Forest Products Ltd</td>
<td></td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
<td>Powys</td>
</tr>
</tbody>
</table>

© Building Research Establishment Ltd 2005
### Structural timber

<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>AOM &amp; Associates</td>
<td>Carmarthenshire</td>
</tr>
<tr>
<td>C &amp; G Barrett</td>
<td>Monmouthshire</td>
</tr>
<tr>
<td>RSW Timber PLC (trade only)</td>
<td>Powys</td>
</tr>
<tr>
<td>Dafydd Cadwladr</td>
<td>Gwynedd</td>
</tr>
<tr>
<td>Hand hewn construction timber &amp; hardwood beams</td>
<td></td>
</tr>
<tr>
<td>Capel Iago Sawmills</td>
<td>Carmarthenshire</td>
</tr>
<tr>
<td>Dickman Sawmills</td>
<td>Carmarthenshire</td>
</tr>
<tr>
<td>Softwood &amp; hardwood, beams lintels etc.</td>
<td></td>
</tr>
<tr>
<td>G&amp;T Evans</td>
<td>Powys</td>
</tr>
<tr>
<td>Gledryn Fencing and Sawmill</td>
<td>Gwynedd</td>
</tr>
<tr>
<td>Mick Jones Timber</td>
<td>Powys</td>
</tr>
<tr>
<td>Air dried Oak beams, any size or length</td>
<td></td>
</tr>
<tr>
<td>D Lloyd &amp; Sons</td>
<td>Carmarthenshire</td>
</tr>
<tr>
<td>Llyyn Timber Product</td>
<td>Gwynedd</td>
</tr>
<tr>
<td>Welsh Oak beams, lintels, Oak framing etc.</td>
<td></td>
</tr>
<tr>
<td>Log-Craft</td>
<td>Gwynedd</td>
</tr>
<tr>
<td>Mynydd Estate Sawmill</td>
<td>Flintshire</td>
</tr>
<tr>
<td>Oak beams, lintels &amp; joists for restoration projects</td>
<td></td>
</tr>
<tr>
<td>The Oak Frame Company</td>
<td>Denbighshire</td>
</tr>
<tr>
<td>Ockenden Timber</td>
<td>Powys</td>
</tr>
<tr>
<td>Powis Castle Estate</td>
<td>Powys</td>
</tr>
<tr>
<td>Green constructional OAK cut to order</td>
<td></td>
</tr>
<tr>
<td>Ridgeway Timber</td>
<td>Pembrokeshire</td>
</tr>
<tr>
<td>William Roberts &amp; Co. Ltd</td>
<td>Anglesey</td>
</tr>
<tr>
<td>William Roberts &amp; Co. Ltd</td>
<td>Gwynedd</td>
</tr>
<tr>
<td>Teifi Timber Products Ltd</td>
<td>Carmarthenshire</td>
</tr>
<tr>
<td>Terne Timber</td>
<td>Herefordshire</td>
</tr>
<tr>
<td>A. Williams</td>
<td>Swansea</td>
</tr>
<tr>
<td>Welsh Oak Frame</td>
<td>Powys</td>
</tr>
<tr>
<td>Wonky Table Company Ltd</td>
<td>Carmarthenshire</td>
</tr>
<tr>
<td>Woodlink Forest Products Ltd</td>
<td>Shropshire</td>
</tr>
</tbody>
</table>
### Packaging and storage

#### Pallets & Crates
- Campws Mona
- G&T Evans
- Charles Ransford & Son Ltd
- Talil Timber Products Ltd.
- Valleys Woodcraft
- Woodlink Forest Products Ltd

#### Presentation Boxes
- Campws Mona
- Theo Davies & Sons
- Fusion Design & Build
- Powyswood
- Valleys Woodcraft

#### Woodchip/Wood Wool
- Arborcraft
- BSN Timber PLC (trade only)
- Dalydd Cardwladr
- G&T Evans
- Woodwood supplied in different grades

#### Addresses
- Anglesey
- Powys
- Shropshire
- Denbighshire
- Camarthen
- Swansea

© Building Research Establishment Ltd 2005
Outdoor features

Bollards & Posts
Charles Ransford & Son Ltd
Ridgeway Timber
Telit Timber Products Ltd.
Teme Timber
A. Williams
Woodlink Forest Products Ltd

Bridges & Stiles
Cefnwyn Timber
GAT Evans
Glaslyn Fencing and Sawmill
Gower Woodland & Charcoal
Lleyn Timber Product
The Oak Frame Company
Powis Castle Estate
A. Williams
Wanken Table Company Ltd

Fencing & Stakes
BSW Timber PLC (trade only)
BSW Timber PLC (trade only)
Cymion Plastics
B. W. Dodd & Son
GAT Evans
M. D. Evans
F.E. Woodlands
Glaslyn Fencing and Sawmill

All timber dried to below 20% moisture content before tongailing.

Heartwood
Clifford Jones Timber Ltd
Leighton Estate
Melinoged Ltd
Powis Castle Estate
Cleaf Oak fencing
Charles Ransford & Son Ltd
J. Roberts
Robins Timber Contracting
William Roberts & Co. Ltd
William Roberts & Co. Ltd
Telit Timber Products Ltd.
Edward Thomas & Son Ltd
Woodlink Forest Products Ltd
ystrad Estate

Shropshire
Penbrokeshire
Carmarthenshire
Herefordshire
Swansea
Shropshire

Ceredigion
Powys
Gwynedd
Carmarthenshire
Penbrokeshire
Shropshire

Gates
Acorn Furniture & Acorn Arborcare Ltd
Oak entrance gates built to requirements, plus
automatic openers
Campus Mona
Cefnwyn Timber
GAT Evans
Glaslyn Fencing and Sawmill
D. Lloyd & Sons
Lleyn Timber Product
Melinoged Ltd
Andrew Millward Joinery
Chris Nangle
Powis Castle Estate
Charles Ransford & Son Ltd
William Roberts & Co. Ltd
William Roberts & Co. Ltd
Stamway Woodcraft
Telit Timber Products Ltd.
Welsh Woodland Products
A. Williams
Wanken Table Company Ltd
Woodlink Forest Products Ltd

Sign Posts
Fusion Design & Build
Lleyn Timber Product

Wrexham
Gwynedd

Garden and leisure

Bark/Woodchips
BSW Timber PLC (trade only)
BSW Timber PLC (trade only)
GAT Evans
Glaslyn Fencing and Sawmill
Clifford Jones Timber Ltd
William Roberts & Co. Ltd
William Roberts & Co. Ltd
Telit Timber Products Ltd.
Woodlink Forest Products Ltd

Charcoal
Acorn Furniture & Arborcare Ltd
Bodfari Charcoal
Dafydd Cadwaladr
Fruit of the Forest
Gower Woodland & Charcoal
Wern Coppice Crafts

Powys
Ceredigion
Gwynedd
Carmarthenshire
Anglesey
Shropshire

Wrexham
Denbighshire
Gwynedd
Swansea
Shropshire

Coppice Crafts
Bodfari Charcoal
Wern Coppice Crafts

Denbighshire
Shropshire

Decking
BSW Timber PLC (trade only)
GAT Evans
Glaslyn Fencing and Sawmill
Clifford Jones Timber Ltd
Melinoged Ltd
Ridgeway Timber
William Roberts & Co. Ltd
William Roberts & Co. Ltd
Telit Timber Products Ltd.
Woodlink Forest Products Ltd

Powys
Gwynedd
Gower Woodland & Charcoal
Shropshire

Wrexham
Denbighshire
Gwynedd
Carmarthenshire
Anglesey
Penbrookeshire
Shropshire

Homebuilding and renovating

Architectural Features

AOM & Associates
Asson & Harmer
Campwys Mona
Capel Iago Sawmills
DJS Joinery
R A France
Gothic Green Oak
Great Oak Glass
G S Leigh
Andrew Milward Joinery
Philip Treake-Johnson Ltd
Wonsoke Table Company Ltd
Woodforms

Cladding & Shingles

AOM & Associates
Edistone Woods
G&L Evans
Gladwyn Fencing and Sawmill
Llwyn Timbrel Product
Log-Craft
Moldyn Estate Sawmill
Powys Castle Estate
Ridgeway Timber
Teme Timber
Wonsoke Table Company Ltd
Woodlink Forest Products Ltd

Conservatories

AOM & Associates
Asson & Harmer
C&G Barrett
Cefn Buarth
Crestwood Joinery
DJS Joinery
Green Oak
Capel Iago Sawmills
G&L Evans
Gothic Green Oak
Mick Jones Timber
Log-Craft
Melingood Ltd
Andrew Milward Joinery
Bridgeway Timber
William Roberts & Co. Ltd
William Roberts & Co. Ltd
A. Williams

Flooring

Adfree Flooring
Sustainable Welsh hardwood flooring
AOM & Associates
Capel Iago Sawmills
Reclaimed flooring
Crestwood Joinery
Machined hardwood floorboards to order
G&L Evans
Sawn & finished to customer’s specification
Heartwood
Local hardwoods
Kenton Jones
Hardwood flooring in Oak,
Sycamore, Birch and grain liles
Mick Jones Timber
Oak and native hardwoods,
Showroom in Arranvilniud,
Carmarthenshire
Melingood Ltd
Andrew Milward Joinery
Oak, Ash, Sycamore,
Elm & Beech
The Oak Frame Company
Native hardwood flooring
William Roberts & Co. Ltd
Teifi Timber Products Ltd.
A. Williams
Large supplier of Oak

Kitchens

Boys & Boden Ltd
DJS Joinery
Fedwen Pine Ltd
Furniture by Jonathan Ewell
HL Design & Build
Free standing kitchens
In all types of wood
Jonathan Guest Furniture Maker
Kenton Jones
William Roberts & Co. Ltd
William Roberts & Co. Ltd
Stannewest Construction Ltd
Tepla Furniture
Free standing kitchen furniture
and new doors for existing units
Philip Treake-Johnson Ltd
A. Williams
Laminated worktops/table tops
in Beech, Ash, Sycamore & Yew
Roger Whitland
Wonsoke Table Company Ltd

Reclaimed Materials

Fedwen Pine Ltd
Capel Iago Sawmills
Oak beams and
newly milled flooring
G&L Evans
Window frames and doors,
wooden sleepers
The Oak Frame Company

Carmarthenshire
Powys
Ceredigion
Gwent
Pembrokeshire
Swansea
Gwent
Ceredigion
Powys
Ceredigion
Powys
Powys
Carmarthenshire
Ceredigion
Gwent
Pembrokeshire
Swansea
Gwent
Ceredigion
Powys
Ceredigion
Powys
Joinery and furniture

General Joinery
S J Amor
M D Broton & Co
Cellfrin House
Llanuwchllyn
Laminated Welsh Oak to architects specification
DJS Joinery
G S Leigh
Andrew hillwood Joinery
One Off Designs
Powys Castle Estate
Stonestreet Construction Ltd
Philip Tuckers Joinery Ltd
Wrexy Table Company Ltd

FURNITURE
Bespoke
Acorn Furniture & Arborcare Ltd
Personal wood turned into a bespoke piece of furniture
Sarah Barry
Cardiff Furniture
Cellfrin House
A unique and personal service for all types of furniture
Thorp Davies & Son
Handmade traditional furniture
Design for Life
Bespoke furniture to commission
Fedwen Pine Ltd
Specialising in hand-made bespoke furniture
Foothill Coachman
Furniture makers and designers using reclaimed wood & materials.
Furniture by Jonathan Dwell
Designers and makers of solid wood bespoke furniture
R A France
Designer and maker of furniture
Fusion Design & Build
Bespoke crafted items, on a commission basis
Gothic Canon Oak
Individually hand made furniture in the medieval gothic style
Jonathan Guest Furniture Maker
High quality furniture individually designed and made using local hardwoods.
Simon Moorhouse Fine Furniture
Traditional & contemporary
hand made furniture in Oak,
Ash, Cherry, Elm & Yew
Chris Nangle Furniture Design
Individually designed solid hardwood furniture
Roger Newman & Sons
Hand made 'Sheep' seats to order
One Off Designs
Bespoke furniture and panelling for individual 'one-off designs'

Nick Over
Period furniture manufacturer
Pwllheli
Furniture made to individual requirements
Pleasant Furniture
Bespoke furniture to order
Robincraft
High quality woodturning & furniture commissions
Telga Furniture
Handmade furniture using traditional methods and materials old and new
David Tyler
"Naturally" designed furniture from local wood
Roger Whwfield
Designer & maker of furniture from temperate hardwoods
Wrexy Table Company Ltd
Traditional handmade furniture to order & commissions
Wood Naturally
Hand-crafted contemporary furniture
Welford
Aesthetic & product design & manufacture
Hugh Whittet Furniture
Individually designed 'one off' furniture commissions

Garden & Outdoor
Richard Austin
Campers Morna
Confolayn Timber
E B Davies
Design for Life
Edstone Woods
G & T Evans
John Gill
Glazebrook Fencing and Sawmill
Llwyd Timber Products
Log Cabin UK
Logcraft
Meadows Design Ltd
Melding Ltd
Chris Nangle Furniture Design
William Roberts & Co Ltd
William Roberts & Co Ltd
Shawcross Woodcraft
Sunderland Softwoods
Arches, pergola's, trellis & swings
Telga Furniture
Telford Timber Products Ltd.
David Tyler
Valleys Woodcraft
A Williams
Woodlink Forest Products Ltd
Wood Naturally

Joinery and furniture

Please note that this is not intended to be an exhaustive overview of timber related businesses in Wales. A detailed, comprehensive file will need to be assembled for the procurement stage, also including information about the size of respective company, capabilities and relevant expertise. The file will also include a detailed directory of biomass (technology and resource) providers in Wales.
CONCLUSION AND RECOMMENDATIONS

The construction of new offices for the Welsh Assembly Government in Aberystwyth, including the Forestry commission for Wales, brings a challenge to designers, procurement specialists and clients alike. As a building constructed at public expense, there is a clear need to demonstrate that current best practice is followed and value for money is obtained. The building will need to respect Welsh cultural traditions and reflect these in the appearance and symbolism for the structure and materials used. Above all, the building should be a model of affordable and effective sustainable development. Timber is an important resource in Wales and the new Welsh Assembly offices in Aberystwyth offer a great opportunity for the timber industry to demonstrate what can be achieved using the Welsh timber resource. This document provides a basis for discussion between all stakeholders involved in the process, whilst identifying the possible uses of timber in general specifically the Welsh timber resource.

This document draws together all the extent and aspects of timber usage, addressing in particular the options for using Welsh timber, envisaged in the construction of a new building. The report establishes the suitability of timber based materials for use in structural and non-structural applications, including

- External and internal walls, screens and partitions
- Post and beam structural frames, roofs and floors
- Windows, doors, internal, external finishes and fittings
- Landscaping and external uses
- Heating and energy (using wood fuel)

A wide range of examples have been compiled in this report to show the applications of timber based products in both traditional and contemporary designs. Increasingly in recent years, timber structures have become leading edge from an architectural, as well as an engineering point of view. Timber applications are based on extensive research and development and references to background reading have been provided in the document for further information. The versatility of timber and its ability to complement other materials has been demonstrated. It has been noted that Wales is already committed to using renewable energy, and initial research into the feasibility of biomass use in the new Welsh Assembly buildings in Aberystwyth has given encouraging results.

In the procurement phase a detailed analysis of the Welsh timber resource, the supply chain, availability of manufacturers and expertise within Wales should be mapped out. Some services and products might in some cases not be available in Wales. However, the initial survey undertaken as part of this report has shown promising potential, outsourcing work only in specialist areas. Especially the use of new technologies, such as green gluing, which enables optimised use of the forest resource and showcases the range of timber species available within Wales. A comprehensive list of Welsh timber related businesses has been compiled to assist the procurement process at a later stage.
## Appendix A – CONTACTS at BRE

Centre for Timber Technology and Construction (CTTC). Key contacts for this report are:

<table>
<thead>
<tr>
<th>Name</th>
<th>Role and Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Julie Bregulla</strong></td>
<td>Timber structures, structural and fire engineering</td>
</tr>
<tr>
<td><strong>Vahik Enjily</strong></td>
<td>Timber structures, structural performance, buildability and procurement (TF2000)</td>
</tr>
<tr>
<td><strong>Chris Holland</strong></td>
<td>Timber resource, material characteristics for structural uses, supply chain</td>
</tr>
<tr>
<td><strong>Geoff Cooper</strong></td>
<td>Timber resource, new technologies, non-structural use of timber</td>
</tr>
<tr>
<td><strong>Ed Suttie and Dennis Jones</strong></td>
<td>Timber durability, treatments and passive protection, bonding agents and fixatives</td>
</tr>
<tr>
<td><strong>Tim Reynolds</strong></td>
<td>Timber construction</td>
</tr>
<tr>
<td><strong>Katie Livesey and Jo Mundy</strong></td>
<td>Environmental performance of timber, biomass and wood fuel heating</td>
</tr>
</tbody>
</table>

Further contacts at BRE (please note this is not an exhaustive list)

<table>
<thead>
<tr>
<th>Name</th>
<th>Role and Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tony Fisher</strong></td>
<td>Foundations and subsidence</td>
</tr>
<tr>
<td><strong>Chuck Yu and Mizi Fan</strong></td>
<td>Board materials, chemical release from buildings</td>
</tr>
<tr>
<td><strong>David Kelly</strong></td>
<td>Disabled access</td>
</tr>
<tr>
<td><strong>Robin Hall</strong></td>
<td>Acoustics</td>
</tr>
<tr>
<td><strong>Gilli Hobbs</strong></td>
<td>Waste and resource management</td>
</tr>
<tr>
<td><strong>Peter Trotman</strong></td>
<td>Condensation and airtightness</td>
</tr>
<tr>
<td><strong>Mike Wright</strong></td>
<td>Lighting and energy</td>
</tr>
<tr>
<td><strong>Richard Hardwick</strong></td>
<td>Procurement and tender specifications</td>
</tr>
</tbody>
</table>

© Building Research Establishment Ltd 2005