The house designs contained within this website (and those constructed at the Anderwood project) are based around a traditionally constructed, heavy structural timber frame. This frame can be constructed from sustainably sourced green oak, Douglas fir, larch or other locally-grown timber suitable for structural use.

'Green' timber means unseasoned timber and is the traditional material used in the construction of timber-framed buildings in this country dating back to medieval times. Timber is easier to cut, chisel and work when unseasoned and will also shrink over time creating stronger joints and more robust buildings.

If correctly sourced, a timber frame can be the most sustainable method of construction. It also provides an incredibly adaptable and flexible building, as internal walls do not need to be loadbearing, which enables complete freedom to decide when and where dividing walls need to be built.

It is important that people considering building or living in a 'green' timber framed building understand some of the particular issues involved with this particular method of construction.

Any cladding of structural timber frames (and in particular green oak frames) is potentially problematic as the timber in seasoning over a prolonged period shrinks and moves as part of its natural drying cycle. This movement often results in distorted sections and shakes, which can cause detailing problems and leaks.

This problem, coupled with recent changes to the Building Regulations Approved Document part L (2006) have placed a much greater emphasis on the reduction of uncontrolled air leakage.

Historically the favoured method of construction is to have vapour control layers and insulation between the frames with a further continuous insulation layer and cladding outside the frame.

The main problem with this construction method was that it relied heavily on the integrity of the vapour control layer. Due to the position of the vapour control layer between the frames and directly behind the plasterboard, it was often punctured by services and opened up around the edges as the frame moved and shrunk.

The level of insulation and control of air leakage now required has surpassed what is feasibly possible with this method of construction.

One solution to this situation, is to ensure that the vapour control layer remains un-punctured and is as effective as possible. In order to achieve this, we have introduced a service zone directly behind the plasterboard (or other internal finish). The service zone runs continuous behind the structural timber frame, allowing for un-interrupted services to run around the building. The service zone will act as a buffer and prevent occurring many of the instances when the vapour control layer is punctured.

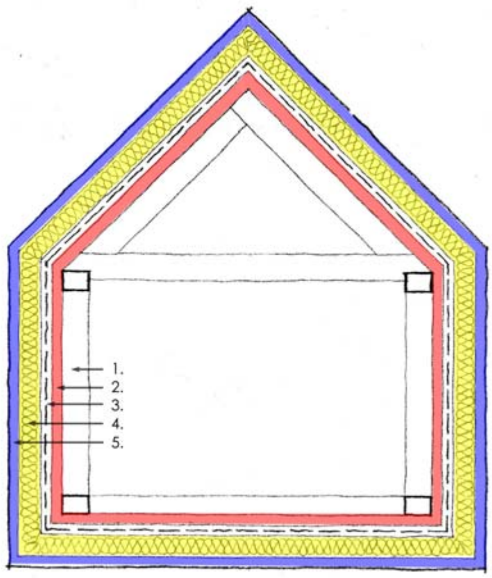
Construction philosophy

The construction philosophy that we have chosen to adopt/follow at Anderwood and elsewhere is one of allowing maximum control for the occupant over his or her immediate internal environment, both in terms of temperature and speed of response to temperature.

Airtightness has become a major performance issue in highly energy efficient buildings. The aim should be to “build tight – ventilate right”, this means that a building cannot be too airtight, but it is essential to ensure appropriate ventilation rates are achieved through controlled systems.[1]

Our approach to achieve air tightness in construction is to separate all the layers of construction and then wrap them continuously around the structural timber frame. We have separated the layers as follows:

1. Structural timber frame
2. Service zone
3. Vapour control layer
4. Insulation
5. Cladding



The separation of the layers and the fact that they wrap continuously around the frame substantially reduces the risk of uncontrolled air leakage through the construction.

Construction Methods for the Secondary Structure

Our investigations of the above construction philosophy have directed us to develop two systems of Secondary Structure; this structure provides the stability to the walls and roofs and supports the finishes to these areas. The main loads are transferred back to the structural timber frame (the primary structure). The two methods used are Traditional details and SIPs (Structurally Insulated Panel systems) details.

We have developed these two systems as there will be situations / projects where, for a number of reasons, one or other system of detailing will be more appropriate.

Traditional Details

This method of construction is a development of the traditional method that has been used on construction site for centuries and is based on the use of timber rafters on the roof and timber studwork on the walls. The difference is that insulation is not placed between these elements – they must be left clear for provision of services. A continuous vapour control layer is then laid over this secondary structure with insulation fixed on top. This development provides an on site method of construction for timber buildings that can meet the current regulations and provide well-sealed buildings for the future.

These details have a number of advantages and disadvantages:

[1] Part L explained The BRE guide, BRE 489, BRE Press, 2006.

Advantages:

- Can be constructed using primarily standard building materials, does not require specialist skills, materials or sub contractors
- Allows design flexibility, changes/alterations can be made on site
- Provides continuous vapour control layer outside the frame
- Provides continuous insulation layer outside the frame

Disadvantages:

- The time between frame erection and the building being weather tight is potentially long
- Quality of construction is dependant on site work
- Purlins and principal rafters are required to be routed to provide wiring channels for lighting fittings on frame

These details are principally (although not exclusively) suitable for:

- Full structural timber frames; including bottom plates, top plates, glazed studs, common rafters etc.
- Small buildings or extensions
- Intricate areas or areas with lots of openings
- Pure curved buildings (a faceted building would work with either system)
- Enclosed sites or sites with difficult access where a crane could not work

SIPs Details

We have investigated the use of Structurally Insulated Panel systems (SIPs) as a method of cladding the outside of the frame with a vapour control layer and insulation panel which ensures an airtight continuous layer of insulation outside the frame.

These details have a number of advantages and disadvantages:

Advantages:

- Fast construction with building weather tight shortly after frame erection
- Quality of construction is factory assured and not dependant on site work
- Provides continuous vapour control layer outside the frame
- Provides continuous insulation layer outside the frame
- Versatile construction method in that it could be used for just the part of the building for which it is suitable i.e just the roof or just the walls

Disadvantages:

- Does require specialist skills, materials and sub contractors
- Does not allow for design flexibility, changes/alterations cannot easily be made on site

These details are principally (although not exclusively) suitable for:

- Primary structural timber frames; not including glazed studs or common rafters
- Complete new houses or large extensions
- Simple or repetitive forms
- Sites with good access
- Simple elements of construction (i.e SIPs roof construction only, with walls in some other construction method)

The system has been developed as a collaboration between Carpenter Oak Ltd, Roderick James Architects LLP and SIPs Industries Ltd.

This method of construction was used on the Anderwood project for the Forestry Commission.

Typical Construction Specification for Structural Timber Frame

We have included specification clauses below from the Anderwood project for the Forestry Commission to assist with understanding some of the issues involved with the use of a structural timber frame on domestic buildings.

STRUCTURAL TIMBER FRAME

GENERALLY:

- Green Douglas Fir heavy structural timber frame, complete with bracing, to be manufactured and erected by Carpenter Oak Ltd in accordance with detailed design drawings certified by Structural Engineer.

- As there are no British Standards or Codes of Practice for heavy Timber Framing, all details, section sizes and joints are to be based on historical precedent.

MATERIALS:

- DOUGLAS FIR: shall be new, English or European steady heart timber, winter felled with low sap content. Refer to 'Selection of Timber' section below for details relating to grading quality.

- STAINLESS OR GALVANISED STEEL: specification of steel for base plates/threaded studs/shoes used for locating foot of internal/external posts to be M20 (unless otherwise specified by Structural Engineer). Must be stainless steel when green oak is used.

- PEGS: pegs shall be either 19 or 25mm diameter dry oak (in accordance with Structural Engineer's details) either cut from dry timber or timber allowed to season for 1 year prior to use. Pegs should have minimum taper necessary for draw pegging and are to be driven tight through the complete member and trimmed 20mm from inside face.

- TIMBER PLUGS: where metal fixings are to be used then these are to be counter sunk and plugged using seasoned timber plugs cut across the grain.

SELECTION OF TIMBER:

- SELECTION: Douglas Fir members are to be selected to suit particular function.

- KNOTS: knots are not to exceed more than 1/4 of the width of the timber face on which they occur. For specific guidance on acceptable knots refer to BS5756: 1997. Rafter's knots are not to exceed 1/3 of width of timber face on which they occur.

- SLOPING GRAIN: generally sloping grain which exceeds 1 in 10 is unacceptable. On glazing studs, sloping grain is to be kept to the absolute minimum and in no instance to exceed 1 in 10.

- FISSURES: length of fissures should not be greater than 2 x the width.

- DISTORTION: bow, spring, twist, and cup are to be kept to reasonable levels to permit ease of construction.

- WANE: wane will not be accepted on any member unless expressly agreed with the Architect.

- SAPWOOD: sapwood is to be kept to the absolute minimum on all sections and in no instance is to be greater than 5% of any section.

- INSECT DAMAGE: wherever possible all wood is to be free from insect damage and in no instance is to exceed the following:

o Pinhole borer's No more than 32 emergence holes per 100mm2.

- o Grub holes — No more than 4 emergence holes per 300mm2.
- o 6mm+ diameter holes are not permitted

- FUNGAL DAMAGE: no decay is permitted other than that found in sapwood.

- STAINING: wood with staining caused by attacks from wood staining fungi to be kept to a minimum. Partial kiln drying of timber members prior to manufacture of frame can be undertaken to minimise possibility of staining fungi – otherwise cleaning with oxalic acid may be necessary at later date.

CONVERSION OF DOUGLAS FIR FROM LOG FORM TO SPECIFIED SECTION:

- CONVERSION: unless otherwise specifically detailed on drawings, all timber (with the exception of curved members) is to be band sawn.

- CONVERSION: members shall be converted as follows:

- o Main posts - boxed
- o Tie beams - boxed or halved
- o Principal rafters - boxed or halved
- o Wall plates - quartered
- o Bottom plates - quartered
- o Mid plates - halved
- o Glazing studs - higher grade timber with no heart content and with only small knots permissible

- CHAMFERS: floor beams and purlins are to be chamfered as standard unless otherwise indicated on the drawings.
- ORIENTATION: all members used in external walls shall be positioned in the works with the heart facing upwards and outwards as appropriate.

FRAMING AND JOINTS:

- GENERAL: frames are to be set out as indicated on the drawings. Frames are to be faced in the traditional way with the upper face orientated outwards.

- MEMBER SIZES: member sizes are given in mm and are to be as shown on the detailed framing drawings.

- NUMBERING: timbers are to be numbered in the traditional sequential method relating to construction. Carpenters' marks should be either Roman numerals or the carpenters' own marks rather than modern numbers. Numbers should be kept discrete and under no circumstances are to be painted

- MORTICE / TENONS: all tenons are to be a minimum of 38mm thick by the width of the timber. Tenon length to vary to suit application and to be in accordance with Structural Engineer's details. In critical positions the tenon thickness may be increased to 50mm. Mortices are to be sized to suit tenons exactly but are to be at least 10mm deeper than length of tenon to prevent bottoming out of the tenon as a result of shrinkage. 19mm diameter pegs are to be set 32mm from the shoulder, and 25mm diameter pegs are to be set 38mm from the shoulder, or as otherwise specified by the Structural Engineer, and should be draw bored nominally 5mm.

- TABLE SCARFS: table scarf's are to be used where possible for joining plates.

- HALF LAPS: rafters are to be half lapped at their apex and splay cut at their feet.

- BRIDLE JOINTS: principal rafters are to be bridle jointed at their apex.

- DOVETAIL TENON: dovetail tenons linking an interrupted tie a post or top plate are to be 50mm thick, shouldered 38mm into the post/top plate and are to be reduced by 50mm to form the dovetail. Each tenon is to be pegged one to three times with a 25mm peg and locked in place with dry oak wedges. A similar arrangement may be necessary at collar level.

- PURLIN JOINTS: joints in purlins are to be located over the principle rafter and are to be splay lapped with 450mm long splays.

- PURLIN / PRINCIPAL RAFTER: purlins are to be set 50mm into principal rafter (unless otherwise specified) and supported with nailed and pegged timber cleats.

GREEN DOUGLAS FIR FRAME ERECTION:

- LAYOUT: Contractor to provide an area of ground adjacent to the works for the laying out of the frame and positioning of crane. The Framer is to check with the Contractor to ensure that the area is suitable for its purpose and is cleared of any plant, materials or other obstructions prior to arrival on site. Contractor to provide power as required by Framer for erection of frame.

- SCAFFOLD: Contractor to liaise with Framer to ascertain date and extent of scaffolding required for erection of frame. Contractor is responsible for supply, erection and subsequent dismantling of scaffolding.

- CRANE HIRE: the Framer will be responsible for arranging crane hire, direction during the course of frame erection, and all costs associated with the hire of the crane. Contractor to liaise with Framer as regards programming of crane hire.

- SUPPORTS: the Framer is to provide all necessary props, straps, chain hoists or other equipment necessary for the erection of the frame.

- ATTENDANCE: Contractor to provide attendance on Framer in accordance with Framer's attendance sheet.

- WELFARE FACILITIES: Contractor to provide Framer with welfare facilities whilst Framer is on site in accordance with health and safety standards current at time of erection of frame.

FRAME CLEANING - MATERIALS AND EQUIPMENT:

- Contractor to arrange for sandblasting of frame by specialist sandblaster familiar with careful sandblasting of green softwood frames, and for subsequent cleaning up following sandblasting. All abrasive cleaning of the frame must be carried out using a dry system. This can either be with traditional sandblasting equipment or by using the JOS system with the TORC dry use nozzle.

- The use of silica sand is not permitted under the Control of Substances Hazardous to Health Regulations of 1989. All blasting material must be clean and new. Use of salvaged material will not be permitted. All blasting material used must be free of any iron, iron oxide or other metal particles which may react with the oak to produce staining.

- Acceptable blasting materials for sandblasting equipment: SC Sand as available from Wolverhampton Abrasives. Tel: 0114 2540600.

- Acceptable blasting material for JOS equipment: UNIL (grade to be agreed with supplier) as available from Stonehealth Limited. Tel: 01672 511515.

- Blasting nozzles are to be selected according to the precision required to reduce unnecessary damage to surrounding fabric.

PROTECTION:

- PERSONNEL: all operatives are to be suitably protected against inhalation and skin contact from the material as set out in the health and safety guidance by the sand supplier and HSE. No personnel other than those involved directly in cleaning are to work within the building at the time of the works.

- OTHER AREAS: any items of joinery, glazing or finishes that are in place are to be adequately protected prior to cleaning. In order to minimise indiscriminate damage of the building fabric, the blaster is to cease blasting when switching from one member to another.

- CLEANED FRAME: all cleaned timber likely to be affected by the elements (weather) to be protected against water staining until the introduction of the glass.

WORKMANSHIP:

- SAMPLE AREAS: a sample area of cleaning is to be carried out on a discrete area of the frame for inspection and agreement with the Architect / Client. The Architect / Client is to be notified at least 5 days in advance of the blaster arriving on site so that inspections can be made promptly. The desired finish is the removal of uneven surface patina including all water stains, dirt foot prints, chalk marks, etc, resulting in a uniform colour to the oak and a minimally raised grain finish.

WORKING METHOD: all faces of timbers should be blasted at an angle rather than face on to minimise the risk of pitting and uneven cleaning marks.

STUBBORN MARKS: where there are areas of stubborn blue-black staining as a result of iron contamination during fabrication, silvering due to UV exposure or excessive water staining, these are not to be over-cleaned thereby bringing up the grain. The blaster is to stop treating the affected area as soon as it becomes apparent that further blasting is not reducing staining. An additional pass over the affected area may be required on inspection by the contract administrator or employer.

CLEANED FACES: all faces of the frame visible on completion of the project are to be cleaned with the exception of those elements inaccessible due to their proximity to adjacent structure/surfaces. Contractor/cleaner to contact Architect / Client if in any doubt as to which surfaces require cleaning prior to commencement of blasting.

SAND REMOVAL: Contractor to ensure that all waste materials resulting from the cleaning operations are removed on completion of the works and cleaned timbers are brushed down with clean non bristle brushes to remove dusting residue.

OCCUPANCY: the cleaner is to advise the Contractor when it is safe to reoccupy the building.

ACCESS: roof structure / upper floor levels: the cleaning contractor is to liaise directly with the Contractor to ensure that adequate access is provided to all elements of the upper floors and roof structure. Access will normally be required such that the end of the nozzle can reach within 500mm of all parts of oak members to be cleaned.