Glass master

MEGA PROJECT

The planed oak on site and ready to work

Follow Keith Smith's step-by-step project to building the perfect oak framed greenhouse. It's horticultural heaven

PROJECT

There is more to a greenhouse than just building a frame and glazing it. A timber greenhouse has a more stable temperature than one with a metal frame, and with the benefit of dwarf brick walls, heat is retained and released during the night. Ventilation is important; for a working greenhouse, and the ventilation used in this design takes into account airflow and exchange; automatic openers are used in the roof lights. Other advantages of this design are the additional height of the roof which allows the heat to build up away from the plants and a good sized door.

Having completed the greenhouse some visitors have said it's 'too good for plants.' Indeed it would make a very attractive orangery or summerhouse with slight modification.

Design

I live in a barn conversion with an original king post trussed roof which has inspired this design. Having made detailed drawings I realised that the design needed simplifying to allow in more light and consulted a structural engineer. The main points which came from this meeting were:

1. Glazing should not be relied upon to add stability.

2. Because the joint at the bottom of each corner post is only 45mm deep, and relatively weak, the stability of the structure rests largely on the top joint of each corner post.

3. The roof needed to be braced longitudinally.

To simplify the design I removed the diagonal braces from each truss and reduced the number of trusses to three. To give the roof its longitudinal stability I included a large ridge board. In my final design I also added a cold frame attached to one side of the greenhouse, **Fig 1**.

Foundations

I chose to use strip foundations to leave the internal layout flexible. I have used reclaimed bricks in the past and they are not always uniform in size or shape. As it's so important to get the brickwork square and level I decided to use new bricks. I could get new Cheshire pre-war coal fired bricks at my local builders' merchant. These bricks look traditional and have some irregularities but are still easy to work.

The roof is glazed with 6.5mm laminated safety glass, this is slightly more costly than toughened glass but, should the glass break, it will be held in position; toughened glass would shower down thousands of tiny but sharp fragments. The door also has laminated safety glass but the rest of the glazing is 4mm float glass

I built a single brick thick wall; if the greenhouse were to be any bigger I would have made it two bricks thick. With hindsight I would have made a pier either side of the doorway, so I have included this in the design

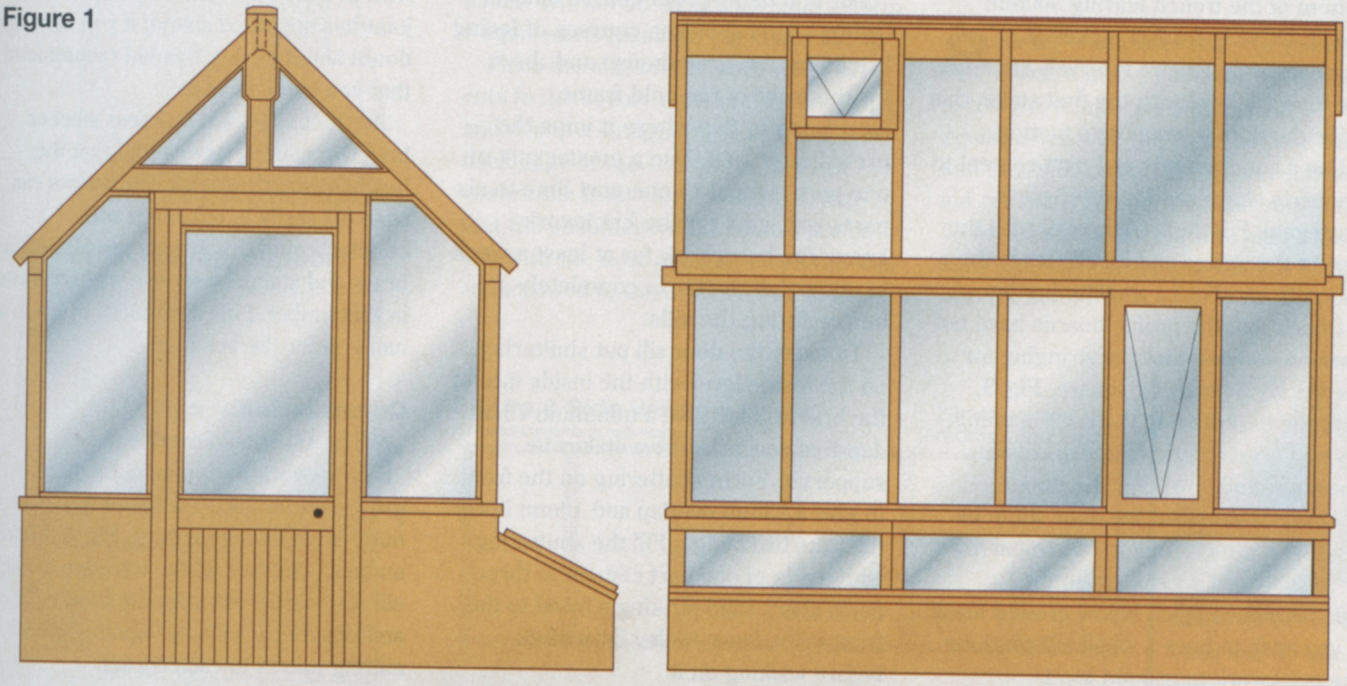
TIP

This greenhouse needed Planning Consent from the local authority. Before starting any such project ask your local planning department if you need permission.

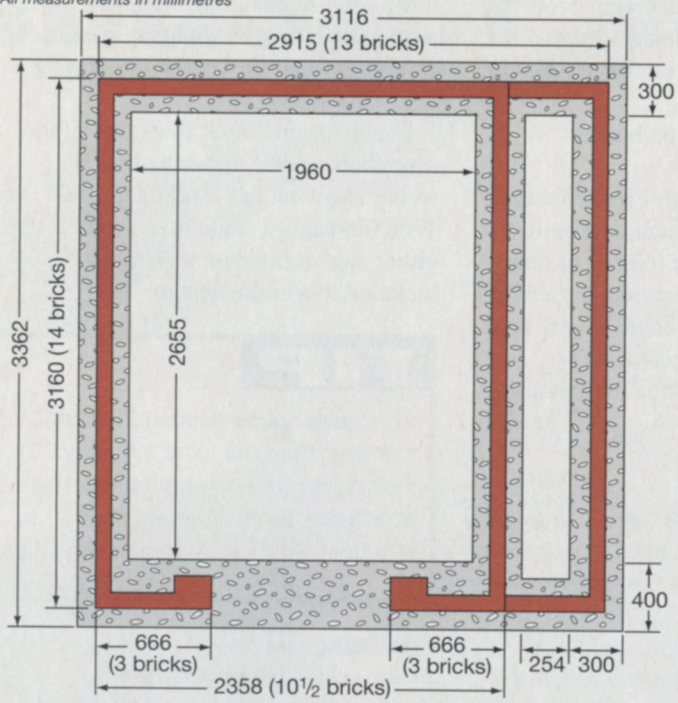
Footings

Set up profile boards to mark the position of the footings and brickwork, site them well away from the work area. Dig 300mm wide trenches 600mm deep, or deeper if you have not reached firm ground. If you plan to grow plants up the greenhouse wall it would be advisable to dig footings at least 900mm deep to allow plenty of soil above the concrete footing, **Fig 2**.

Figure 1



Figures 2-3 Concrete footings and brickwork
All measurements in millimetres



Figures 4 Sill *All measurements in millimetres*

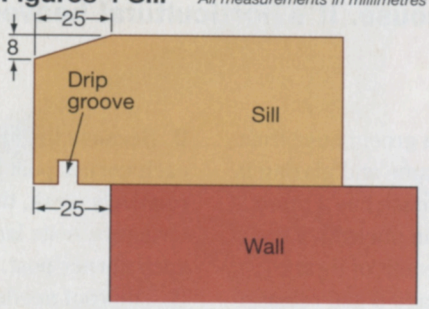
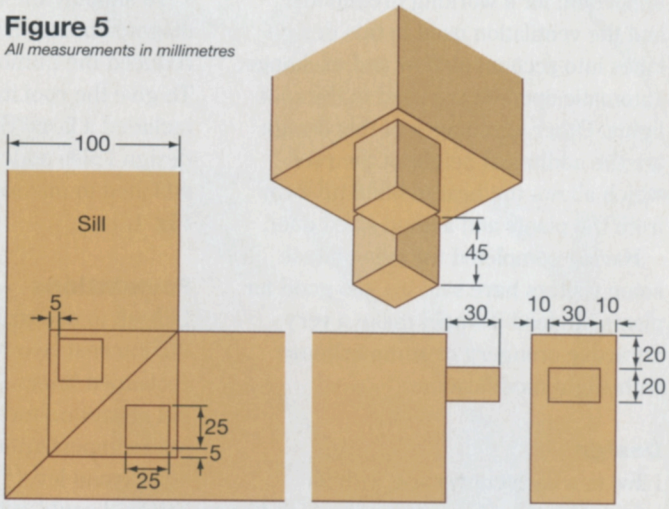


Figure 5
All measurements in millimetres



If you intend to include the cold frame, use the same depth of footing as the greenhouse. This may seem excessive, but differing depths of foundations will almost certainly cause the wall to crack.

Ensure the bottom of the trench is level; drive a 400mm stake into the bottom of the trench leaving 300mm proud. Drive in further stakes at approximately 1metre intervals ensuring the tops are level with the first stake; this is the depth of the concrete footing.

Use a concrete mix of 1 part cement to two parts sharp sand to three parts aggregate. Fill the trench level with the tops of the stakes and ideally leave the concrete for about a week to harden.

Check that the profile boards have not been moved and that the stringing for the bricks is perfectly square, **Fig 3**, with the exception of the door opening, lay engineering bricks to two courses above ground level. For the door opening; if you want the door sill to be level with the ground, for wheelbarrows or for disabled access, finish the brickwork one brick below ground level. If you wish to have a small sill continue the brickwork to ground level.

TIP

If you want to install power and water, lay the pipes at this stage before back filling the trench,

Put in a damp-proof course before laying a further seven courses of facing bricks for the greenhouse and three for the front of the cold frame increasing to five where it joins the greenhouse wall. Use a mortar mix of one part cement to one part lime to six parts soft sand for the brickwork. Leave the brickwork for at least a week to allow the mortar to completely set before fitting the sills.

To make the door sill put shuttering on the inside level with the inside face of the brick wall to give a minimum 75mm depth of concrete, drive stakes to support it. Form shuttering on the front to give a 25mm overlap and 10mm lower than the back edge. Fill the shuttering with a mix of one part cement to three parts sharp sand striking a bevel to the front edge, leave to dry for a week before walking on it.

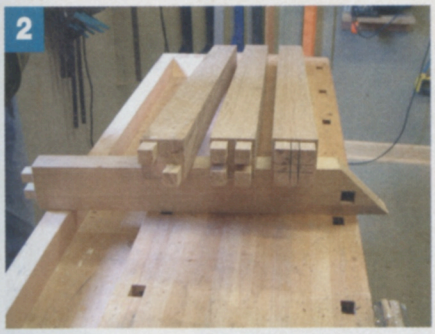
The woodwork

I used polyurethane glue throughout, it's convenient, waterproof and I took advantage of its gap filling quality which should keep any moisture out of the joints. However polyurethane glue has little strength unless the joint is a very good fit. I have had a couple of failures with polyurethane glue, even when the joint has appeared sound; if you have any doubt about a joint, I would recommend that you use Extramite.

All the fixings are stainless steel or brass. Because I have found that the heads of stainless posidrive screws can snap off easily in oak, even with counterboring, I now only use slotted brass and stainless screws when working in this timber. I used stainless brads in a nail gun for the beadings.

Construction

1 The sill should overlap the brickwork by 25mm; cut a drip groove under each sill 10mm from the outer edge and 8mm deep, **Fig 4**. Make an 8mm chamfer on the top edge of each sill starting 25mm from the front edge and ensure the sills are square before cutting mitres to each corner.

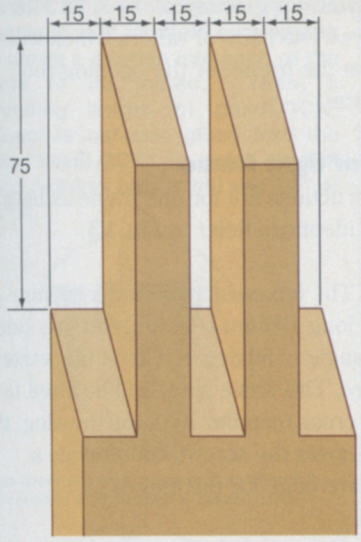


2 Mark out the mortise in each corner, use a 25mm auger to drill a 40mm deep hole in the sill and square up with a chisel, **Fig 5**. Make a stub tenon in each of the short sills where it will be mortised into the door frame. Ensure the timber for the four corner uprights is of the same dimension (75mm square) and square, cut to 1070mm.

3 Now cut the twin tenons for the top and the pair of stub tenons for the sill (**pic 2**), check the twin tenons are in line with the wall plate. These are paired. The top tenon is 75mm long to make a through tenon for added strength. **Fig 6**. The wall plates project 50mm beyond the outside edge of the corner posts to provide additional strength to the joint. Make twin mortises in the wall plates.

Figure 6 Twin tenons (top corner posts)

All measurements in millimetres



4 Make four temporary supports from ply or MDF and 25mm square timber as shown in **Fig 7**. Fit the mortises in the corner posts into the sills; this should pull the mitre in the sill tight (but not too tight) if it doesn't, use a thin piece of wood in the joint to act as a shim, **Pic 3**.

5 Measure the exact distance of the sides between the corner posts and the height from the sill to the shoulder of the top tenon; make two frames from 50 x 25mm with 50mm square uprights to form 6 equal sized openings, **Fig 8** and **Pic 4**.

Place the sills on the wall; screw off-cuts to the square ends of the short sills and clamp a straight piece of wood to the back edge of the short sills, this will ensure the front sills are aligned, and that the shoulders of the tenons are in line with the door opening when the sills are screwed to the brickwork, **Pic 5**.

6 Apply a slow-setting glue to the tenons in the bottom of the posts and their mortises. Assemble the joints; the mitres should be pulled tight. Ensure the sills are square; drill and countersink the sills 35mm from the back edge. Screw the sills to the brickwork using 135mm frame fixers.

7 Place the side window frames in position ensuring they do not project above the shoulders of the corner posts. Apply polyurethane glue to the sill and posts, fit the side window frames and clamp in position. The joint at the top of the post is critical to the rigidity of the structure. Use Extramite for this joint.

8 Fit the wall plates onto the posts; check that the posts are vertical; screw the temporary supports in position between the posts and the front and rear sills using 50mm steel screws to aid removal. Temporarily nail some 25 x 50 battens between the wall plates to add some stability. Screw the window frames into position, **Pic 6**.

Figure 7 Temporary support

All measurements in millimetres

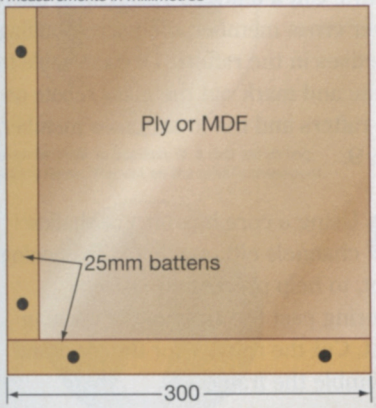


Figure 8 Side window frame

All measurements in millimetres

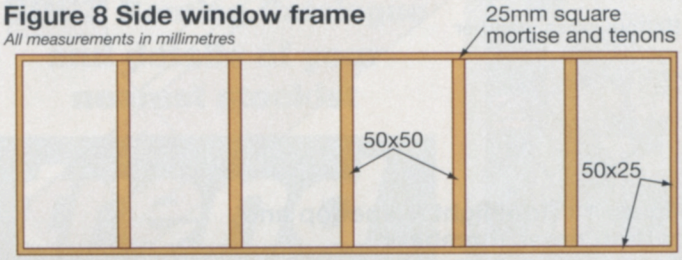


Figure 14
All measurements in millimetres

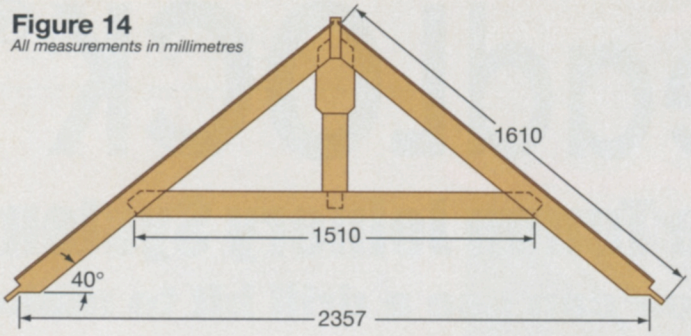


Figure 15
All measurements in millimetres

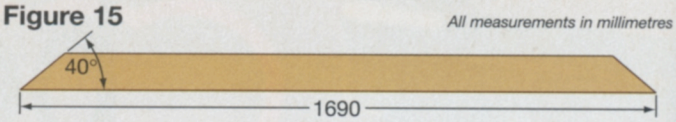


Figure 16
All measurements in millimetres

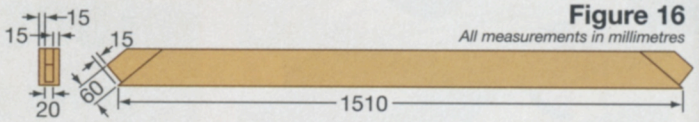


Figure 17
All measurements in millimetres

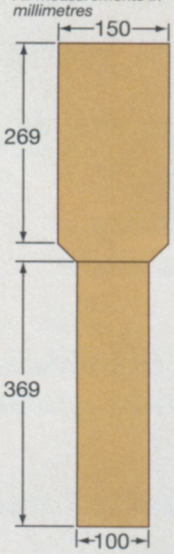


Figure 18
All measurements in millimetres

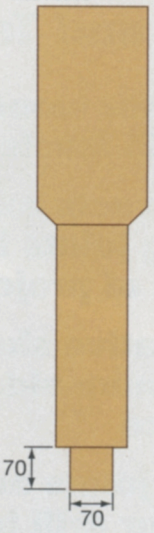


Figure 19
All measurements in millimetres

The author's oak greenhouse nears completion

Roof trusses (Fig 14)

1 Thickness all the pieces for the trusses to the same measurement. Cut the tie beams to 1690mm at 40 degrees, **Fig 15**. Cut tenons in each end, **Fig 16**. Shape the king posts, **Fig 17**.

2 Cut tenon at bottom of each king post, **Figs 18 and 19**. Now cut a corresponding mortise for the king post in the centre top of each tie beam. Pair up the rafters into two end pairs and one middle pair according to the rebate for the glass.

3 Make up one truss; the other two can then be made identical to the first. Mark the mortises for the tie beam on the rafters and cut out. **Fig 20**.

4 Fit together the tie beam and rafters, leaving a gap at the ridge for the ridge board. Lay the king post on the frame and mark the shoulders of the top tenon. Cut the tenon in the top of the king post.

10

11

5 Cut out the centre section of the tenon for the ridge board, **Fig 21 and Pic 10**. Cut mortises in the rafters to correspond with the tenons in the king post. Use a piece of scrap wood the same width as the ridge board to act as a spacer and assemble the frame. Use this as a template for the other two rafters so that they are identical, bearing in mind they are paired, the end frames are not reversible because of the glass rebate, **Pic 11**.

Figure 21
All measurements in millimetres

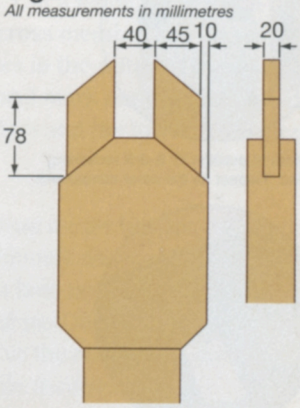


Figure 20
All measurements in millimetres