MISSION IMPOSSIBLE PART 3

In the third of this four-part series, **Shaun Newman** describes how the soundboard should be made, braced and fitted, as well as describing how to inlay the rosette

In part 2, I described how the back of the guitar should be fitted and bindings and purflings put into place. Work then began on the head and neck as well as on the use of the Halsschraube (neck bolt) to enable the guitar to be fitted together.

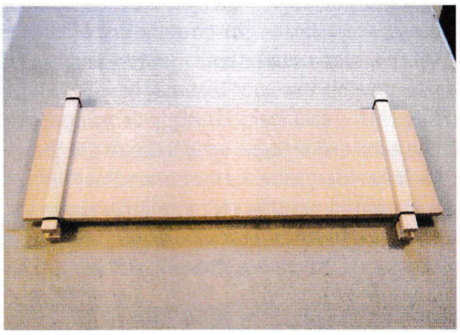
The soundboard

Every stringed instrument maker will say that the soundboard is by far the most important component of the entire build. The very finest of timbers should be used, and in the case of spruce or cedar only the narrowest grain available, dead straight and entirely knot-free pieces, should be chosen. For this instrument I chose fine quality Engelmann spruce, which is delivered from the supplier as two 'book-matched' halves, each around 5mm thick (**photo 56**).

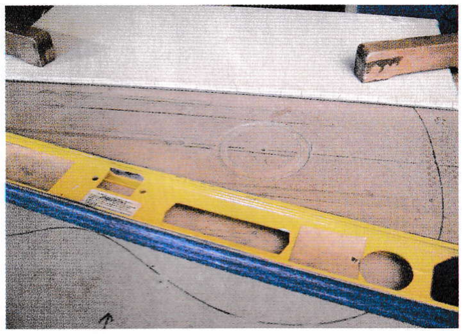
The first task is to join the two sheets along the centre, and this involves planing the inside edges true and ensuring perfect contact along the entire edge as was the case with the back. While truing the edges that will be joined with the old spirit level described above, I found it useful to put a series of pencil lines along the two edges. Once they have all disappeared, you know the edges are true (**photo 57**).

Once more the wedge and lace jig is used to pull the two parts of the soundboard together (**photo 58**), and Titebond is used as the most appropriate adhesive. I am often asked: 'Why Titebond?' Well, the answer is a little lengthy, but understandable. Hot hide glue, which has been used by luthiers for centuries, remains a favourite among many. It is, however, susceptible to infestation and weather changes and comes apart easily if an instrument is subject to dampness or, for example, is accidentally dropped. It does, however, help in repair work as it often cracks easily making it more straightforward to dismantle a piece. Standard PVA (e.g. 'Woodwork W') or similar can 'creep', especially under pressure. For example, if a bridge is glued down with PVA it can slowly move over time under the pull of the strings and the instrument will not play in tune. So, Titebond is easy to apply, easy to clean up and dries brittle, which means it does not interfere with the acoustic qualities of the instrument. It does not creep, it sands and planes easily and all round is probably the adhesive used most widely in the world of lutherie.

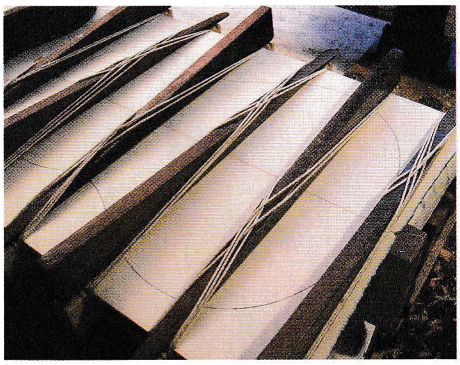
Back to the soundboard. Once it has been removed from the wedge and lace jig it should be cleaned up on both sides ready to receive the rosette. It should not, at this point, be brought down to its required thickness of just 2.5-2mm.



56 Book-matched Engelmann spruce as supplied



57 Pencil marks help to show when the butt join is perfect



58 The soundboard in the wedge and lace jig

59 Some commercially available rosettes

The rosette

The rosette on this instrument is the next task to consider. At this stage the maker has a choice: on the one hand a homemade rosette can be fitted, or alternatively, one that is commercially available can be chosen. I have made well over 100 classical guitars and only made my own rosette a handful of times. The reason is very simple and that is the commercially available ones are really not expensive and can be very detailed and beautiful indeed. Life is too short for some jobs (**photo 59**).

Once the decision has been made, a channel should be cut into the soundboard front to house the rosette. This can be achieved through a circle


Newman
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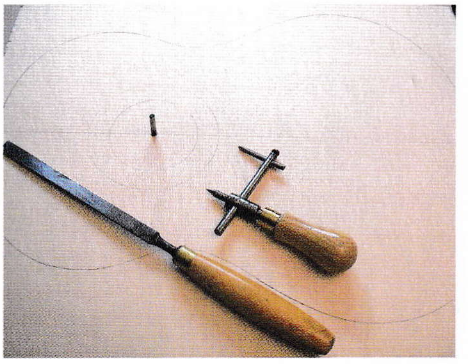
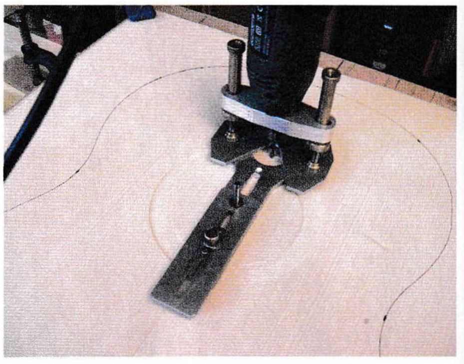
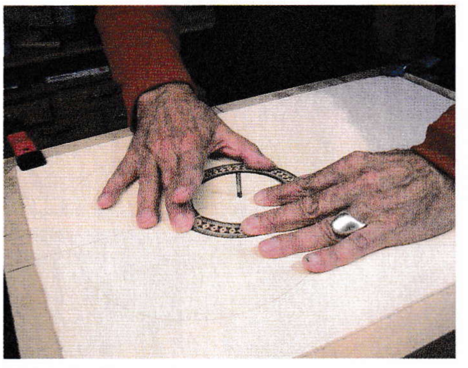
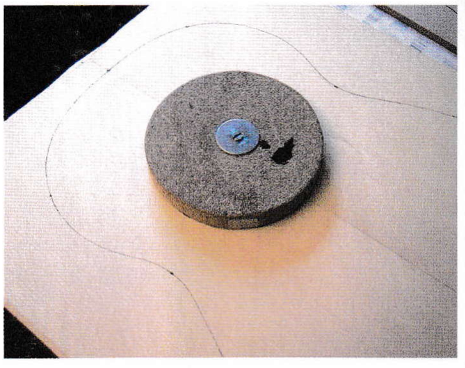

60 The circle cutter and chisel approach to inlaying the rosette


61 The Dremel in use to cut the rosette channel


62 Inlaying the rosette


63 Rosette caul

cutter set to the inside and outside edges of the rosette measurements and with a centre hole 160mm from the top edge of the soundboard where the 12th fret will sit. The centre of the rosette, of course, also serves as the centre point for the sound hole.

I have to say that although using the circle cutter and taking the housing out by hand with a very sharp chisel is good woodworking practice (**photo 60**), I find it much more straightforward to use a trammelling router. The base for such a tool is quite easy to make (Rik Middleton has described how to make a simple one in his book, *The Guitar Maker's Workshop*) though I decided to invest in the mini router base made by Waverly for the supplier Stewart Macdonald. It is designed for use with a Dremel and can give a very accurate cut to the finest edge of the rosette and is easy to set to the correct depth (**photo 61**). Once the housing is cut the rosette may be inlaid (**photo 62**) and held in place with a circular caul, which is secured to a workboard with a screw through the centre (**photo 63**). Don't forget to cover the face of the caul with parcel tape otherwise it can get very attached indeed to the soundboard and rosette...

Thicknessing the spruce

Most classical guitar soundboards are reduced in thickness to around 2.5-2mm depending on the density of the timber, its elasticity, and a sort of 'feel' for when it is right. For my classical guitars, I usually bring the treble side down to 2.5mm to offer a little more rigidity, while the bass side is brought down to 2mm to allow for the longer wave length notes to flourish. The reduction is first achieved with a No.5½ plane, working on the back of the soundboard to prevent damage to the rosette (**photo 64**) and finished by hand sanding on both sides with a cork-faced block. At this point the soundboard is very fragile and needs to be handled with the utmost care. It becomes much more robust when the bracing bars are in place.

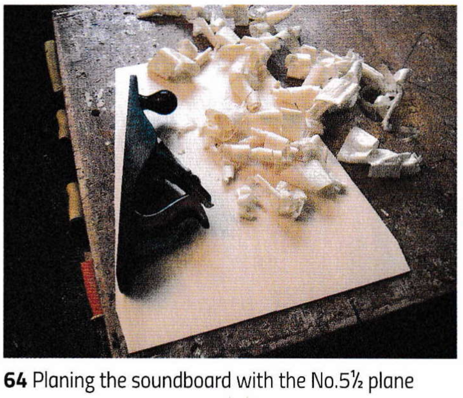
Bracing the soundboard

There are almost as many bracing patterns as there are makers and each one is slightly different. Many makers feel they have been the creator of the perfect example. In the early days the braces were placed horizontally across the inside of the soundboard, and this was called 'ladder' bracing. Many notable makers such as Panormo, Lacote, Staufer and Farbricatore used such methods. There were others but it was largely Antonio de Torres, the renowned Spanish guitar builder, who changed all of that and introduced 'fan' bracing, where they radiate like shafts of sunlight across the inside of the soundboard. For a couple of hundred years, variations on the fan bracing structures were developed, and I am using one of them here, modified slightly by myself (**photo 65**). The most modern trend is to use lattice bracing, pioneered by such makers as Greg Smallman, and they can be very effective, provided you are fond of the sound of a banjo!

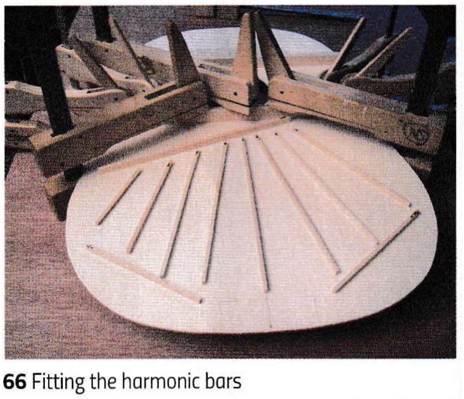
The eight fan braces are each 3mm wide and 4mm deep and are put into place using 'beam' strength, i.e. with 4mm of height.

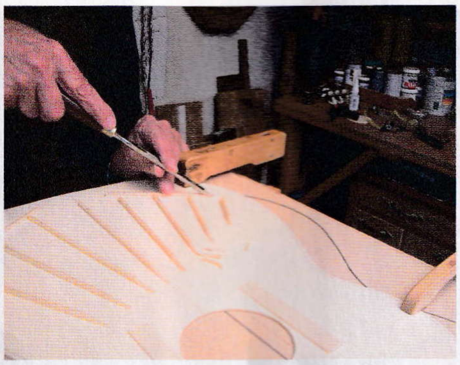
Once the fan bracing has been attached it is time to fit the harmonic bars (**photo 66**), the sound hole strengtheners and a brace under the end of the fingerboard to help prevent shrinkage splits in the upper bout of the instrument. The two harmonic bars, which run horizontally above and below the sound hole, are each 15 × 6mm and are slightly curved with a 1.5-2mm lift. This helps to prevent the soundboard from looking sucked inwards when the instrument is completed and the finish is applied, and it offers a little more strength. The two sound hole strengtheners, which run vertically between the harmonic bars, are 13mm wide and 1.5-2mm thick. The upper bout shrinkage preventer, which sits above the harmonic bar, is also 1.5-2mm thick.

Once everything is in place the ends of the fan braces should be scalloped down to around 0.5mm in height, and the ends of the harmonic bars to 4mm (**photo 67**). The reason for the tapers on the fan braces is to prevent 'pimples' from appearing on the front surface when the instrument is finished due to the force exerted by the curves in the harmonic bars and the pull from the bridge through the very thin material of the soundboard. The scallops in the ends of the harmonic bars will sit in small housings in the ribs, as was the case with the back. Just below each housing small braces are put into place on the insides of the ribs, to aid sound distribution and to help prevent the harmonic bars from springing out of place in years to come. Finally, the harmonic bars are gabled with a small block plane before a steel ruler is placed over the ends of the fan braces to help avoid damage (**photo 68**).


64 Planing the soundboard with the No.5½ plane

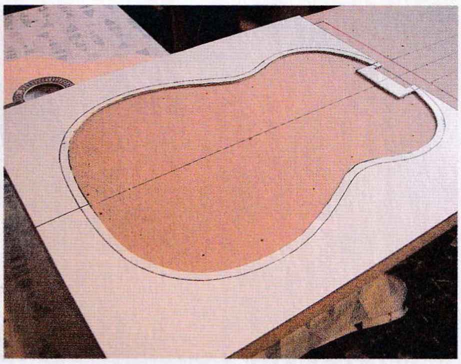

65 My fan bracing pattern


66 Fitting the harmonic bars



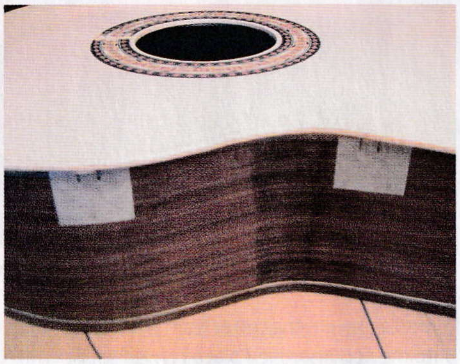
67 scalloping the fan brace ends

68 Gabling the harmonic bars



69 Workboard well for soundboard

70 Testing the tops of the ribs for flatness



71 Marking the housing slots for the ends of the harmonic bars

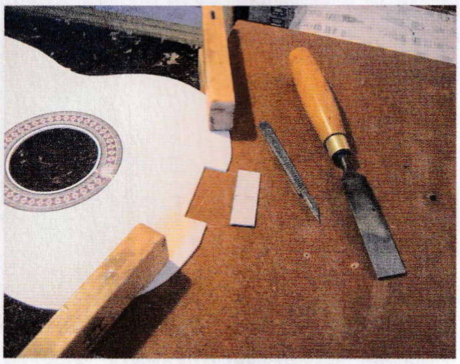
Fitting the soundboard

As the soundboard now has a slight curve to its shape, it cannot be placed directly onto the workboard and the ribs then pushed down onto it. Instead a 'well' should be created to allow the belly of the soundboard to drop below the perimeter edges. This well is made from a piece of hardboard, which is faced with white film and is around 3.2mm thick. Such sheets are easily available from DIY outlets. A clear centreline must be drawn along the length of the sheet before the next stage, which is to transcribe the outline of the soundbox onto the hardboard, then a 5mm cut is made around the inside of the outline until the middle section drops out. The cams are removed from the workboard and the remaining piece of hardboard is temporarily tacked onto the board ensuring it follows the centreline, is equidistant from either end of the soundbox outline, and that the outline sits exactly over the original one marked out on the workboard (**photo 69**).

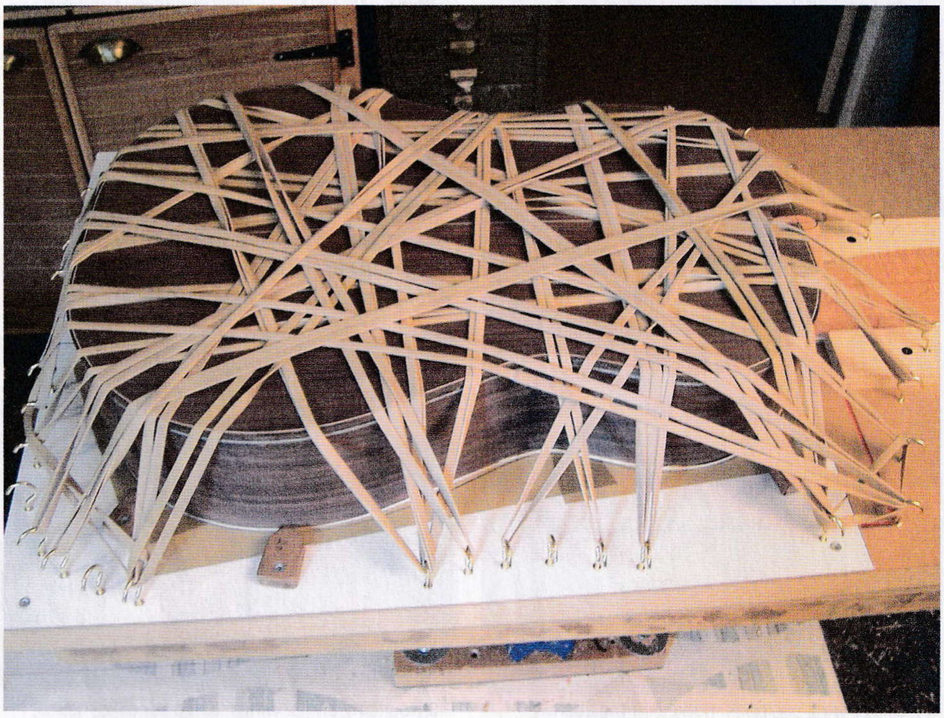
Before the ribs can be held down onto the inside edge of the soundboard, a set of kerfed linings must be fitted to offer support to the edges. These kerfed linings are made in exactly the same way as those described for fitting the back, i.e. they are taken from a length of timber 19mm high and 6mm wide, cut into a triangle along its length and prepared with saw kerfs 6mm apart along the oblique edge. This time, however, the lining is made from spruce, beech or lime, rather than mahogany. There is no real reason for this other than tradition and the belief by some makers that choosing these woods will improve the sound. The linings are fitted along the inside edges of the ribs with small cramps and once fixed must be levelled with a flat sanding stick. The flatness of the tops of the ribs can be tested with a simple jig made from two pieces of straight-grained pine. The longer piece is housed into a slot on the underside of the crossbar and may be slid backwards and forwards. Where a gap appears in the housing, the tops of the linings are too high (**photo 70**).

As mentioned earlier, the ends of the two harmonic bars are next to be housed into the linings/ribs. The positions are marked out by placing the soundboard over the ribs and using masking tape to identify exactly where the housings should be cut (**photo 71**). The Dictum razor saw is an excellent tool to cut such small housings. When the housings are cut it can be very clearly seen where exactly the soundboard will sit, so the small overlap covering the top of the neck mortise can be removed with a dovetail saw and chisel (**photo 72**).

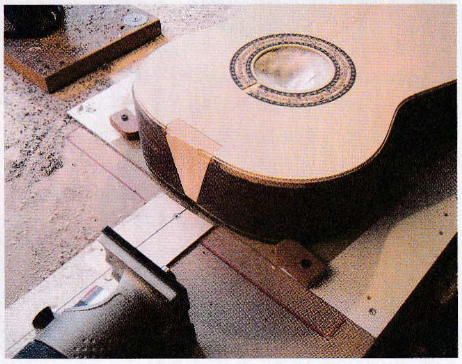
Next, a series of cup hooks are once again screwed to the workboard. These will be used as anchor points to the long elastic bands, which are stretched over the structure while the Titebond is curing. It is important that the soundboard does not slip out of line while the ribs are fitted, so a handful of cams are used to bear against the edges of the soundboard to prevent any



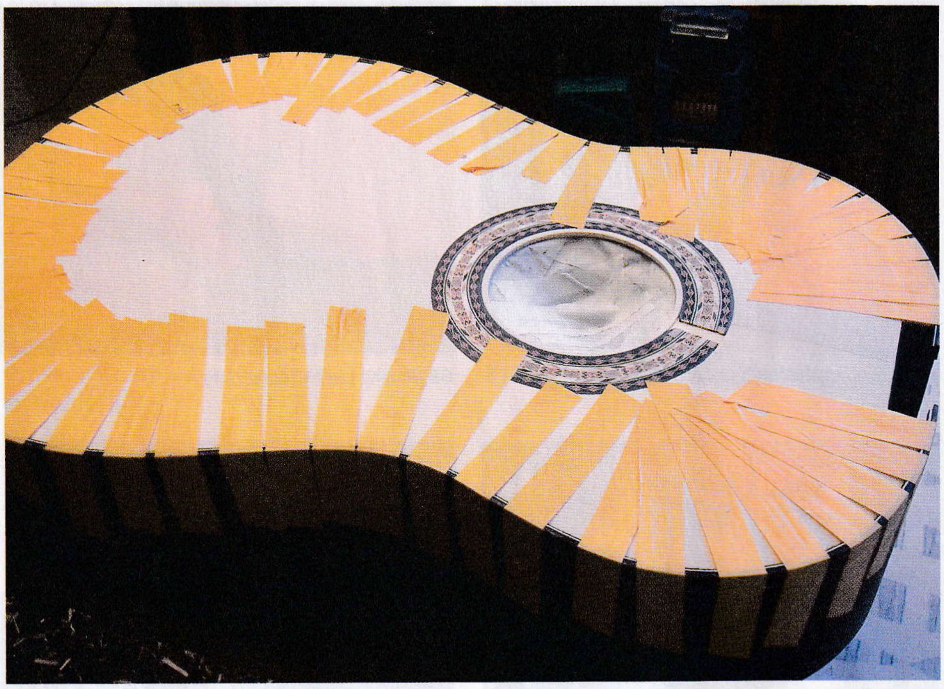
72 Small section of soundboard removed



73 Elastic bands are used to fix the ribs down onto the soundboard



74 Wedge in neck mortise to help in cutting bindings/purflings channel



75 Soundboard bindings and purflings held with masking tape

movement. When everything is secured, the top edges of the linings are covered with a film of adhesive and the ribs are lowered down onto the soundboard. The elastic bands are stretched over the structure corner to corner alternately. It reminded me of tightening the cylinder head on my 1952 Ford Anglia way back in the 1960s. The pressure supplied by the bands is surprisingly strong and a perfect join is easy to obtain (**photo 73**). Next, once the Titebond is cured and the soundbox is removed, the first thing that strikes you is just how light the whole thing is. Light, but really very strong.

Attaching bindings & purflings onto the soundboard

As mentioned earlier, the purflings are for decoration, but for the soundboard they also act as a barrier to prevent the colour from the rosewood bindings from bleeding into the pale spruce of the soundboard. The binding channels are cut in the same way as for the back, but this time, to prevent the cutter from wandering into the neck mortise, I placed a wedge of maple into the gap and held it in place, just below where the cut would be made with masking tape. This gives a very clean edge to the channel. A secondary cut is then made for the purflings. In this case the purflings are 2mm deep and 1.5mm thick (**photo 74**).

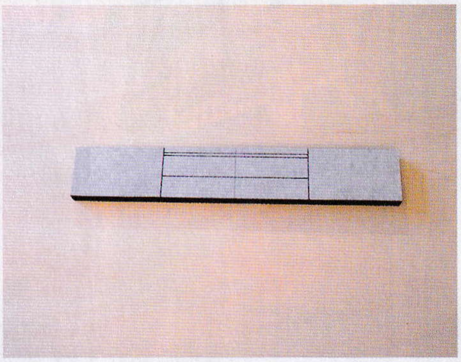
76 Ebony blanks/billets for the bridges

Once bent to shape the bindings and purflings can both be installed at the same time in the same way as for the back, i.e. by using strong masking tape to hold them in place. During this operation it is really vital to press the bindings and purflings very hard into place to avoid gaps after the tape has been removed (**photo 75**). As mentioned earlier, with a rosewood back it is not too much of a problem as rosewood dust and CA adhesive can be used to fill any discrepancies. However, if gaps appear in the front, then it is very difficult to hide them as they show up badly against the pale spruce.

The bridge

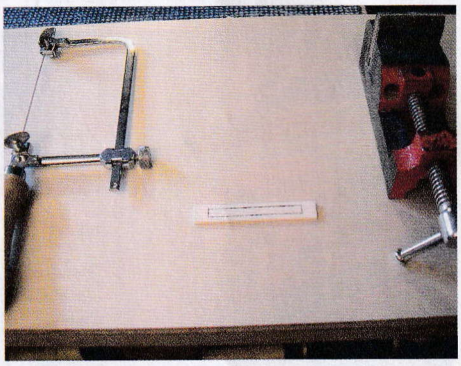
The bridge is a very important component of the build, as a superior quality soundboard can be ruined by a bridge which is the wrong weight, made of the wrong timber, or is the wrong design. Most classical guitar bridges are made from either rosewood or ebony, though with more and more restrictions on endangered species, other woods such as katalox, fruitwoods, maple or even kingwood and snakewood may be used. Eventually the bridge should weigh around 50g, as lighter would not drive the soundboard, and heavier would deaden it. For this instrument I chose ebony and began with a billet 192mm long × 30mm wide × 10mm thick (**photo 76**).

The first job was to ensure it was dead flat on either side and during this operation the thickness was reduced to around 9.5mm. From either end the wings are marked on tape over the ebony at 55mm (**photo 77**). These wings are in turn reduced in thickness to 4mm on the top side, which is then curved to offer the component some elegance (**photo 78**). The space between the wings is devoted to housing both the tie block, for the strings and the bone saddle to hold the strings up off the fingerboard. These are separated by a trough, which allows the strings to pass through the tail end of the tie block and up over the saddle. The tie block is normally covered in a hard material to prevent the strings from digging channels into the block, and it is common to use bone for this purpose. Some makers, notably the Spanish luthier mentioned earlier, Antonio de Torres, would sometimes leave



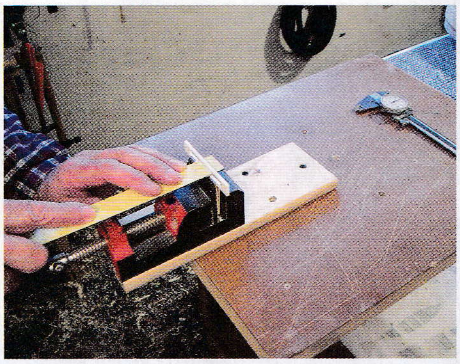
77 Bridge wing positions marked on the ebony

78 Rounding bridge wings with a sanding stick

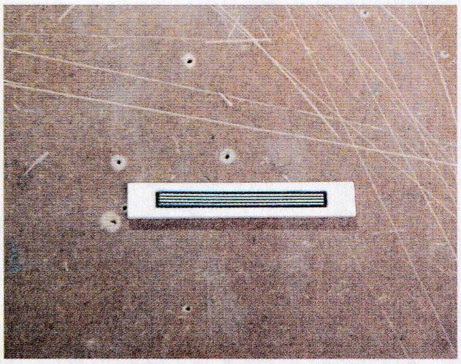


79 Tie block bone marked out for inlay

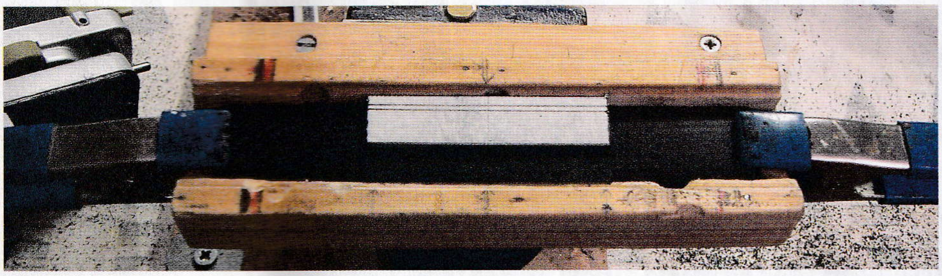
80 Cutting a hole in tie block bone with a pearl saw



81 Filing the inside edges of the tie block bone



82 Tie block inlay in place



83 Saddle slot marked out on the bridge

the bone as a plain blank, but most makers like to decorate this part of the instrument. I chose to inlay some pieces of purfling into the bone, which first involved marking the inlay position onto the bone (**photo 79**), cutting an oblong hole with a fine pearl saw (**photo 80**), filing all inside edges very flat and clean (**photo 81**), and then pushing the purflings into the gap and securing them with CA adhesive. Plain strips of black and white purfling (black tulipwood and sycamore) made up the simple inlay (**photo 82**).

5mm in from the opposite side to the tie block a channel is cut to house the bone saddle (**photo 83**). This channel can be cut with a dovetail saw, or it can be removed with a mini router. I chose the latter as it helps to have a very flat and even bottom to the channel, which ensures that the bone saddle is in contact with the bridge along its entire length. This greatly aids sound production. The channel is normally around 4.5-5mm deep and 2.5 or 2.6mm wide.

Cutting the trough is tricky, but with a sharp chisel held at an angle it can slowly be excavated. The bottom of the trough should leave just 2mm of wood beneath it, as the strings will pass through holes drilled into the tail end of the tie block, 3.5mm from the base of the bridge. The inside of the trough should be sanded thoroughly smooth so that the strings can slip over the inside edge easily. Finally, the top ends of the bridge are chamfered to meet the feather edge created along the sides. This helps once again to lend a little elegance.

At this point some makers will carefully curve the underside of the bridge to fit the slight contour of the soundboard. I have tried this and left the bridge flat and have never been able to hear any sound difference.

The bridge should be held in place with long-throated clamps or even weights. There is always the danger that it will move out of line the moment you take your eyes off it after it has been clamped. To avoid this two 2mm holes are drilled down through either end of the saddle bone slots. When the exact position of the bridge has been determined, which is 650mm between the top edge of the fingerboard and the inside edge of the saddle slot, the position of the two holes is marked onto the soundboard and the bridge can be held in place with two cocktail sticks (**photo 84**). The bridge is then held in place with long-reach clamps (**photo 85**). When the adhesive has fully cured, the cocktail sticks are snapped off on the inside and chiselled flush with the bottom of the saddle slot. ⚒

84 Cocktail sticks help to prevent the bridge from sliding out of line

85 Bridge clamped into place

SUPPLIERS OF MATERIALS, TOOLS & ACCESSORIES

- **www.stewmac.com** – for all materials, tools, plans, drawings and accessories
- **www.touchstonetowoods.co.uk** – for timber and tools, rosettes and bindings/purflings
- **www.tonetechluthierssupplies.co.uk** – for timber and a wide range of tools
- **www.luthierssupplies.co.uk** – for timber, tools, rosettes and tuners
- **www.madinter.com** – for exotic timber, tuners, rosettes and tools
- **www.tonewoods4luthiers.co.uk** – for beautiful, exotic timber
- **www.dictum.com** – for fine quality tools
- **www.londonguitarstudio.com** – for strings, sheet music and many accessories
- **www.magic-guitar-parts.com** – for good quality tuners
- **www.smallwonder-music.co.uk** – for inlay materials, purflings, etc.

READING LIST

- *The Guitar Maker's Workshop* – Rik Middleton – ISBN 1-86126-040-7
- *The Classical Guitar, Design and Construction* – Donald McLeod and Robert Welford – ISBN 0852190778
- *Guitar Making Tradition and Technology* – William Cumpiano and Jonathan Natelson – ISBN 0811806405
- *Making a Spanish Guitar* – Jose Luis Romanillos – ISBN 13008619001
- *Classical Guitar Making* – John Bogdanovich – ISBN 9781402720604
- *Making Master Guitars* – Roy Courtnall – ISBN 0709048092
- **Make Your Own Classical Guitar** – Stanley Doubtfire – ISBN 0805238336
- *Classical Guitar Construction* – Irving Sloane – ISBN 0860012328

NEXT MONTH

In the fourth and final part of this project, Shaun adds the fingerboard and frets, top nut and saddle bone, a finish, strings it up and sets the action, before making a bespoke flight case