Making Violas: Reconciling Size and Sound
Talk given at Lutherie 2006 Conference, Newark on Trent, 13 May 2006
by Helen Michetschläger

I'm particularly pleased to have the opportunity to talk about one of my main areas of interest, making violas. This is going to be a practical rather than a theoretical talk, based on my experience of meeting and working with many viola players and teachers, discussing ideas with colleagues and trying things out at the workbench.

I think that making violas is one of the most interesting aspects of violin making today. Players demand powerful and responsive instruments in a size they can manage. As there are fewer good old violas than violins or cellos, viola players are often less conservative in their expectations. This gives us as makers a wonderful opportunity to be creative; to experiment and to test out ideas.

My talk will fall into two main sections: viola design, covering size and model, and then a discussion of making techniques as relevant to violas. The talk is intended to give a general overview of all the considerations that are particular to making violas. My aim is to show the links between all the different aspects of the work rather than to go into great detail on each topic.

Before we start, I must apologise for the typical British confusion with measurements. Although I work mainly in metric, there is no escaping measuring the length of back of a viola in inches. For those who prefer, the metric equivalents of all the main back lengths are as follows:

Viola back lengths: inches/centimetres
15 inches = 38.0cm
15 ¾ inches = 40.0cm
16 inches = 40.5cm
16 ¼ inches = 41.2cm
16 ¾ inches = 42.5cm
17 ¼ inches = 43.7cm

When I refer to small violas, I mean a back length of 15 ¾ inches or less.

SECTION 1 – VIOLA DESIGN

I'd like to discuss the general design of the viola in terms of what I think is comfortable for players and acoustically successful; all makers will have their own ideas about the models they like to copy, or whether they want to develop their own designs.

Size

At the time that the classical Italian violin makers were working, the viola as a solo instrument did not exist, and the music written for the instrument was less technically demanding than that written for the violin or cello. The baroque set-up gave violas a shorter neck than is modern practice. Almost all string players of the era, and certainly the professionals employed by court orchestras, were men. All in all, considerations of ease of playing the viola would not have been a significant issue for either the players or the makers of the time.

Leaving aside the early large tenor violas, most classical contralto violas were around 15 ¾ inches – 17 inches in size, with a concentration around the 16 ¼ inch mark.

The viola emerged as a solo instrument in the early years of the 20th century, thanks to the efforts of Lionel Tertis, William Primrose and others. Tertis himself favoured a rich, cello-type sound and was totally dismissive of violas less than 16 ¾ inches in length; he played a 17 ¼-inch Montagnana viola for most of his career. Tertis was a man of strong views and was adamant that only large violas could work. His views have perhaps influenced players who often feel that the bigger the better. In my opinion, this view is overstated.

The modern world is different. The music written for viola: the orchestral, solo and chamber repertoire is as demanding as that for any other instrument. Long hours of rehearsal and performances as well as the incidental rigours of travel dictate the need for a comfortable instrument. Around 50% of professional orchestral viola players in the UK are women, and amongst students the proportion is higher.

The constraints on size for the viola player come from two areas; the size of hand and the length of arm.

The left arm of the viola player will be straighter than if they were playing the violin. The straighter the arm, the less the scope there is for the elbow and hand to rotate, reducing the freedom and flexibility of the left hand. This means that the larger the viola, the more tension in the left hand and arm.

This shot shows the detail of what happens to the left hand if the string length is too long for the player. To reach across to play on the C string, the fourth finger is stretched so that it is almost flat. This causes an overall loss in flexibility which makes it harder to play fast notes and to do vibrato. It also creates tension and pain down the hand and arm.

It's vital for us to understand these physical constraints for players in order to develop models that suit them. We need to try to understand all aspects of the design and practice of making violas, so that we have the flexibility to adapt what we do to meet the varying demands of players.

Even teachers and players can be surprisingly unaware of the consequences of playing too large a viola. I had a customer who had gone all through Music College with an instrument that was much too large for her, suffering periods when she couldn't even

play. Neither she nor her teachers realised that there could be a link between the size of her viola and her problems. Only later, when she had a few lessons with another teacher was she told to look for a smaller instrument. Once she bought something well within her comfort zone, she went on to have a busy freelance career.

Model

Having looked at the problems faced by players, we'll now turn to the instrument itself. As I talk about the design and practice of making violas, I will touch on some of the ways of making manageable sizes which retain the power and quality usually associated with larger instruments.

I'd like to go through all the different parts of the viola and discuss some of the aspects of design as they relate to sound and playing comfort. I've picked this picture of a viola by the Venetian maker Anselmo Bellosio to illustrate a few points worth looking out for.

Length of back

Although as I've said, most classical violas have a length of back of between 15 ¾ and 17 inches or so, the upper end of the scale is too big for most people to manage. The main area of demand for violas is now between 15 and 16 ¼ inches.

Outline

The most important acoustic consideration as regards the outline is that the middle bouts should be reasonably wide; that you have an instrument without a pronounced waist. This seems to be important for giving richness and depth to the sound, and an A string with a darker viola quality. I would look for around 135mm (measured across arching) for a 16" viola.

But it's better if this idea of increased width is not carried across to the upper and lower bouts. From the player's point of view, wide upper bouts make it difficult to stretch up to the higher positions. Over-large lower bouts can give an uncomfortable feeling of bulk for the right hand to get round to bow the instrument. From my own experience, and talking to colleagues, I've not found any real evidence that wide lower bouts give any acoustical advantage – maybe even the reverse. It's quite striking when you look at good classical violas, such as the Bellosio above, that many of them have outlines which are relatively rectangular – i.e. a wide waist and not particularly wide lower bouts.

Rib heights

A& H Amati
c.1620

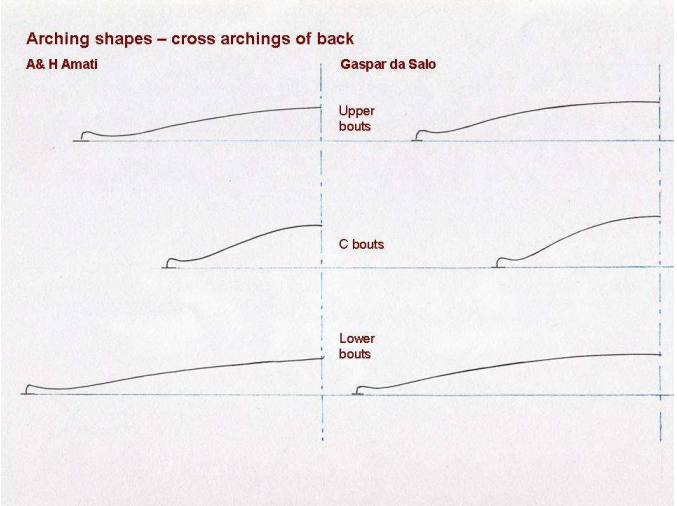
Rib heights
36-38mm

Paolo
Maggini

Rib heights
32-33mm

Classical violas usually have a rib height of around 36 or 38mm, and violas with very high arching usually have ribs which are rather lower than this, sometimes even less than 34mm. In an attempt to improve viola sound, some makers have experimented with rib depths of at least 40mm, but this risks making the sound hollow and lacking in
focus. It's worth noting also that players with short necks find deep-ribbed violas uncomfortable because they have to almost stretch their necks to get round them.

Arching shapes



The viola's darker, alto register is harder to project than the sound of either the violin or the cello. A critical aspect as regards power and projection of the viola is arching.

Simple, strong arching shapes seem to work to enhance the power of the viola. Violas often sound better if their arching is a little fuller to the edges than violin arching. Both power and character of sound are enhanced by this. In this respect, the arching shapes of the Brescian makers are worth looking at. To illustrate the point, here are the back cross-archings of violas of the Brothers Amati and Gaspar da Salo. The Gaspar shapes are very much stronger – there's hardly any scoop into the edges and the main curves of the arching are more convex. This makes for stronger plates, which incidentally can then be worked thinner, but more of that later.

It's worth mentioning again that overall arching height must be thought of in conjunction with rib height; lower arching and deeper ribs or vice versa.

F-hole size and spacing

I think of the central part of the viola front; the bridge and the area between the f-holes, as the "motor" of the viola. When the instrument is played, the vibration of this area is responsible for a lot of the sound generation. The two main things to consider are the width between the upper eyes of the f-holes and the overall length of the f-holes. I like to keep a minimum distance between the eyes of the f-holes of 46mm, so that even on a very small viola you can fit a standard bridge. Some additional width beyond that is often beneficial, as it can contribute to a darker sound. The length of the f-holes then helps to create the necessary flexibility, so if the f-holes are very widely spaced you might like them to be a little longer than otherwise. On a small viola, you might also want to keep the spacing and the length as large as possible, so that this central area works more as if it were a larger instrument. To return to the "motor" analogy, you may have the body of a small car, but you've kept the high performance engine.

Head design

Antonio Stradivari viola 1696 *Archinto*

Many beautiful historic violas have heads with shoulders, like small cello heads. Unless you have a client who specifically requests this, it's best avoided. The shoulders can get in the way of the player; even viola players with large hands generally find the shoulders to be an encumbrance.

It's also worth keeping the head as small as possible. If you're copying an instrument with a largish head, think about reducing it in size from the original. Any given weight feels heavier the further away it is from the trunk of the player. A viola head doesn't need to be much bigger than a violin head; you need only to think about possibly slightly thicker pegs and the marginally thicker strings.

Stop length

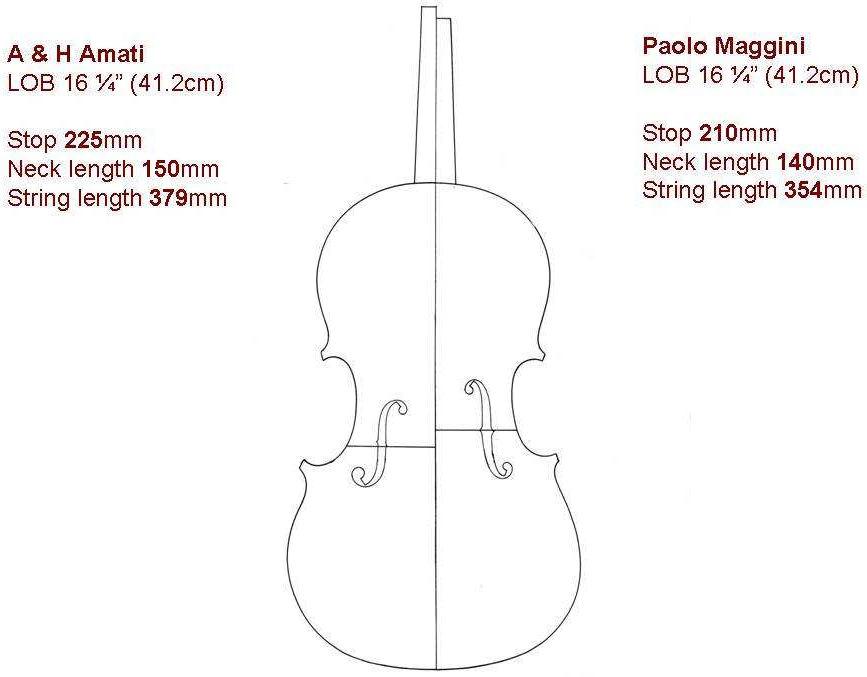
Stradivari 1696 *Archinto* Maggini

It's usual to measure violas by back length, but the vibrating string length, measured from the nut to the bridge, can make an enormous difference to the feel of an instrument.

The string length is largely determined by the stop length, measured from the top edge of the instrument to the nicks of the soundholes, where the bridge is usually placed. There are two basic standards. The Cremonese-type model is in this respect

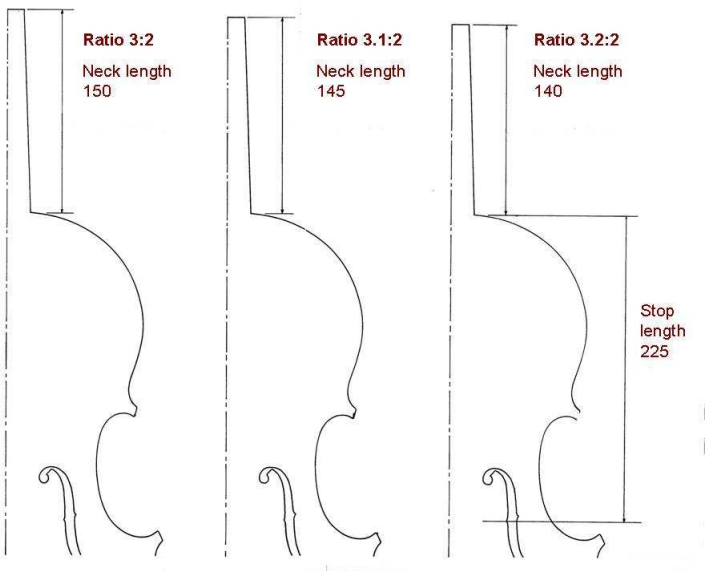
closer to an enlarged violin. The Brescian-type model has the bridge at, or close to the centre of the instrument. This difference is quite apparent when you put two similar size violas from the different schools together.

Stop and string length



As the neck length is in proportion to the string length, the illustration above shows the variation in string length produced by different stop lengths. There is a full 25mm difference in string length between the two models, which has a significant effect on left-hand facility for the player.

Neck: stop length ratio



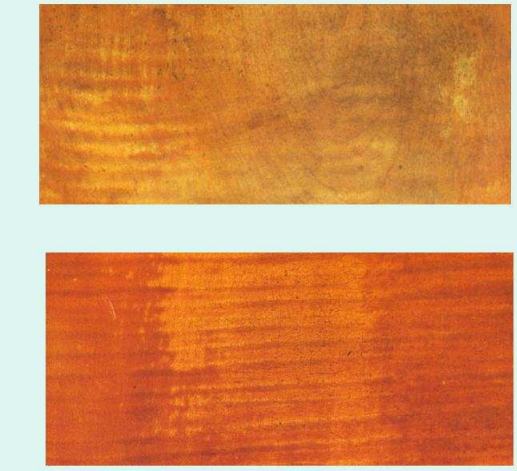
In order to reduce the string length of longer stop violas, it's common practice to reduce the neck to stop ratio. The standard is 3 to 2, the same as a violin. For any given stop, the measurement is divided by 3 and multiplied by 2 to give the neck length; the neck length is two-thirds of the stop length. A shorter neck length can be achieved by dividing the stop by a slightly larger number, 3.1 or 3.2, to give the neck lengths as shown.

A small amount is often a good idea, but the higher ratio risks making the viola feel a bit harder to get round. Third position is effectively further up past the heel of the neck, so there's more of a stretch to reach the higher positions.

Viola measurements table
I find it helpful to keep a note of the main measurements of all my different viola models, so that it's easy to compare them. I keep them in an excel file which can then be easily updated when new information is added.

SECTION 2 - MAKING TECHNIQUES FOR VIOLAS

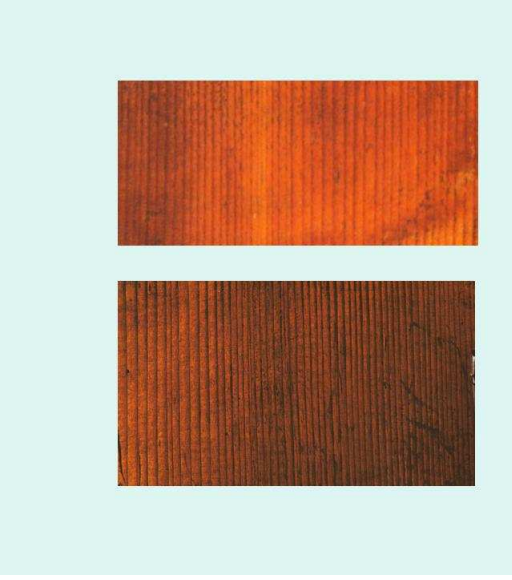
Wood choice



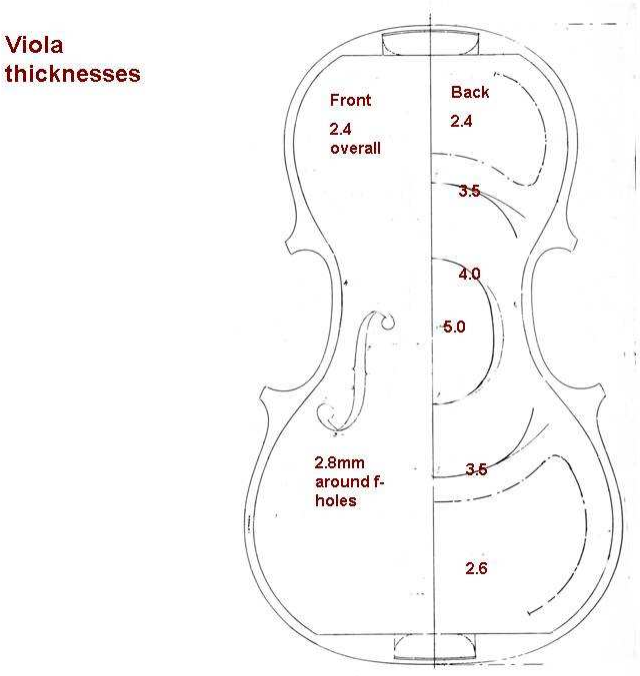
Maple - It's much more usual to find slab-sawn maple on violas than it is on violins. Slab-sawn wood is less stiff across the grain than quarter-sawn, so it helps to give a warmer, darker sound quality. As it's also less strong than quarter-sawn wood, it's usual to leave it a little thicker, but it's important not to overdo this. It's interesting to note that it's frequently found on Brescian instruments, which have the strongest arching shapes. I'd guess that the strength of the arching enabled the makers to keep the thicknesses low without unduly weakening the back.

Wood density
It can also be helpful to consider wood density, as it can be difficult to achieve the desired balance of weight, stiffness and thickness with very heavy wood. I find this particularly useful to do for maple, and would choose wood below 0.65g/cm³. This is even more critical with smaller violas.

Spruce – look for wood with stronger, more widely spaced reed lines, which enables the front to be made a bit thinner without losing strength. A lot of good-sounding classical instruments have this, and I had no problem at all finding pictures to illustrate the point.



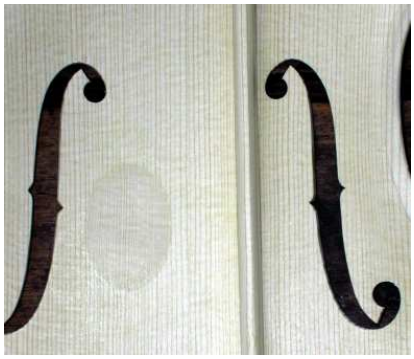
Thicknessing



It's a mistake to think that because violas are larger than violins, the back and front should be thicker. Thinner plates vibrate at a lower frequency, and for violas this is necessary to support the lower pitch of the viola. In his book "The Secrets of Stradivari", Simone Sacconi gives thicknessing diagrams for both violins and violas. The thickness of the front that he indicates is the same for both violin and viola, and for the back he gives an extra 0.5mm for viola in the central area, 0.2mm in the next ring, with the rest remaining the same as a violin. Given strong arching shapes and good wood these thicknesses are fine to follow, and for smaller violas it can be wise to go even thinner. I'd work on the principle that if you were to make a violin and viola of the same body length, the viola plates would be thinner.

Thicknesses alone are, of course, not the whole story. It's important also to consider weight, stiffness and tap tones, and to look for a balance between all these aspects. As regards weight, for a 16-inch viola I like around 150g for the back and 90g for the finished front including bass bar. Stiffness is hard to quantify. It's worth spending time with each instrument you make, flexing the plates in all directions to get a feel for how they move.

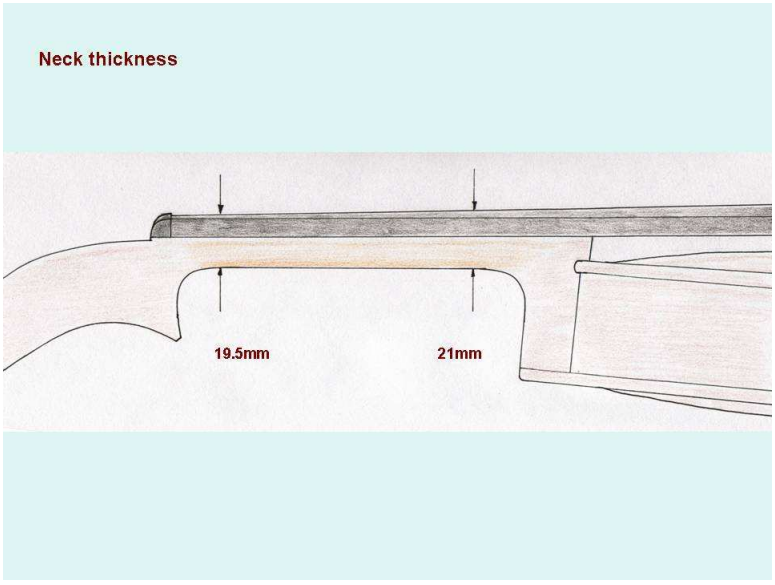
It's also good to try pressing the arching, which can be done either on a finished instrument or on the loose plates. I would always want there to be some give when the plate is pressed in this way.



If, as I do, you like to make viola fronts quite thin, it's a good idea to consider the strength of the front in the soundpost area. You want to avoid soundpost cracks or distortion of the arching over time. Rather than leave the wood thicker in this area, it can be helpful to glue a small superficial patch of spruce to the front, about 0.5mm thick in the middle. This gives a lot of extra strength in this area without unduly stiffening the front.

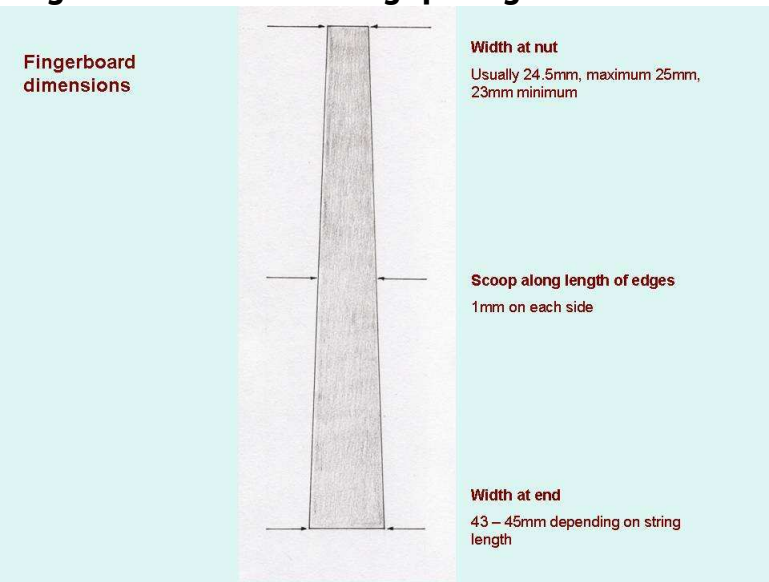
It goes without saying that it's a good idea to take detailed notes. Where I can, I like to organise data on an Excel spreadsheet which can be updated and sorted according to model with each new instrument I make. The principal things I record like this include the size and model of instrument, date or number to identify the individual instrument, wood density, plate weights, slab or quartered back. The system can of course be enlarged to include anything you like. Once a few instruments have gone in, you quite often find patterns emerging, with common features appearing amongst instruments you were more or less happy with. Though there is one big caveat with this; there are always things that you can't measure and maybe don't even notice. These may have at least as much bearing on the finished instrument as the things that you can easily measure.

Neck size



There is no real reason for viola necks to be significantly larger than violin necks. For sub 16" violas, which will often be played by people with small hands, it is worth considering using exactly the same measurements as for a violin, and only increasing them slightly for larger instruments. The measurements indicated on the diagram are a good average; I'd prefer not to go much less than this for risk of compromising strength. You could add on a bit for a very large viola or someone with big hands.

Fingerboard size and string spacings



The diagram indicates the normal dimensions. For players with very small hands, it can be useful to consider reducing the width at the nut end down to as little as 23mm, with a corresponding reduction of string spacing to 16mm. I would not normally reduce string spacing at the bridge below 37mm, as that would inhibit the vibrations of the bridge itself.

Fittings

Chinrest

You can save some weight by choosing the chinrest carefully. Boxwood is notably lighter than ebony; for one of the larger over-the-chinrest models the difference is at least 10g. Large and heavy chinrests can sometimes mute the instrument.

String choice

A number of string manufacturers now make viola strings in different lengths according to the size of the instrument. It's well worth checking this out and buying the appropriate size, particularly for sub- 15 inch or very large violas. Gut strings are usually designed for a string length of around 370mm, and don't perform well if there is much variation on this. Synthetic and steel strings will work happily over a much greater range of string lengths.