Davide Sora

Article published on MVA Michigan Violinmakers Association newsletter (2017)

Archings

Arching is the most powerful tool that the violin maker has to try to direct the acoustic response of the instrument to its own sound idea. Technically, it is also the most difficult to control as it requires an ability to visualize the shapes strongly developed and interiorized by observing the widest possible number of instruments with recognized acoustic quality. The first aspect of which you must be aware of, however, is that the original archings are always distorted by the tension of the strings and of the sounpost. It therefore appears evident that at the time of construction the shapes had to be different from those that can be seen at present. In addition, the arching process takes place with the wood block not internally hollowed, therefore very stable. Already the phase of the internal hollowing will lead to a more or less light but inevitable deformation, followed by other possible deformations during the gluing of the bassbar and the ribs to the plates. Surely the back is the one that suffers less than all these deformations, although it is not unharmed, while the top plate is literally "transformed" because of its greater flexibility due to the type of material and the presence of the F-holes. Another cause of modifications is the flexion caused by the two staggered planes of the gluing surface of ribs, typical of the Cremona school, by the greater stress caused by the direct pressure of the bridge and the asymmetric distribution of the pressure caused by the presence of the sounpost. Trying to reconstruct exactly the shape that had to have the "classic" archings at the time they were made is not easy because of the complexity of the bowed instruments structure, but I personally do not think that exactly copying the shape of the archings of the ancient instruments is the only way to go. Even if we were able to reproduce exactly the curves of a "historical" arching, these would be irremediably distorted by the tensions and these deformations, although having the same origins, may vary according to differences in the material (eg grain and seasoning of wood) or according to environmental conditions which would lead to different results than the original. By observing the work of ancient violin makers without any preconceptions, we can see that the application of a standard has never existed and that even the violin makers operating in the same city, even if they were part of a typical "school" (as it was, for example, in Cremona during the time when the Amati, Guarneri and Stradivari worked) were able to vary a lot their work. Experience has led me to develop the arching of my instruments starting from the observation of classical instruments (and possibly from the listening of the sound of these instruments) to arrive through the reasoning and observation of the behavior of my instruments over time, to have all the available information to figure out how to make the arching that best suits the characteristics of the wood that can "give" me the sound I have in mind.

The goal I am aiming at is to allow the archings to achieve a balance that can withstand the tension while retaining their ideal shape, avoiding the failure and ensuring a greater longevity and stability of the acoustic response of the instrument. Over the years I have slowly developed a working method based more on visual perception of curves and sensory sensitivity than on pre-set measurements and models. In this way I can adapt the curves I'm making to any variation in the measurements of the heights of archings, different widths of plates and any outline asymmetries. To have the profiles of the fifths or the sixths of some famous instrument can be a good starting point for a good arching, but instead of being content with copying them, it is essential to understand the trend of the curves to develop the ability to form a three-dimensional mental image of the whole arching that allows to adapt to the evolution of shapes during the work. To do this, it is necessary to create reference points on which to base the observation, identifying the starting and arrival areas of the curved surfaces and the passage areas from concave surfaces to convex surfaces, developing a more objective view of the overall shape.

The sixth

During the construction, after performing a general gouge roughing, I first define the longitudinal profile of the sixth using a block plane. The continuous curve thus obtained will be practically the final one and will no longer be touched in subsequent working except in the final finishing of the surface with scrapers.

Gouge roughing

Top plate roughed with the gouge

Back plate roughed with the gouge

Block planes used for the sixth

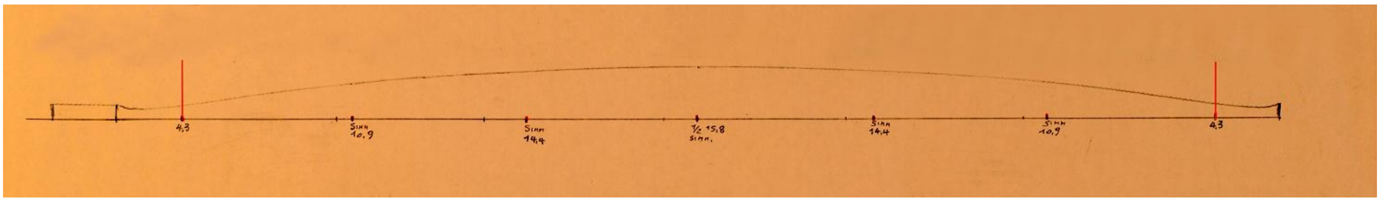
Planing the sixth

Top plate sixth finished with planes

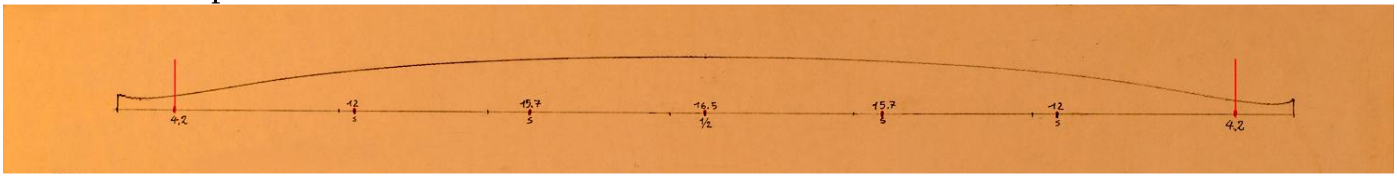
Back plate sixth finished with planes

The sixth of the top, in classical archings, often has a somewhat wide rectilinear area (sometimes even sunken), ending with somewhat swollen and accentuated curves in the upper and lower bouts, with little extension of the concave curve of the channel. This aspect is largely due to the deformations caused by compression of the top for the string tension and bridge pressure: the combination of these two forces leads to a shortening of the sixth with a rise of the upper and lower bouts and a straightening of the central line. In my sixth, I try to take account of these deformations by eliminating any flat area in the central area and flattening the curves of the upper and lower bouts in order to obtain better opposition to the compression forces of the neck and the pressure of the bridge. The back sixth deforms in the opposite direction to the top mainly due to the presence of the soundpost, though usually less significant thanks to the greater thickness and strenght of the maple. Taking this into account, I try to make a more regular curve approaching a circle arc, while the one of the top will be more like a parabola. In both cases, I symmetrically set the curves by dividing the convex part of the curve (excluding the channel) into six equal parts by placing the maximum height in the centre.

Sixth of the back



Sixth of the top



<u>**The channel (fluting)**</u>

Then I continue with the fingerplane roughing, always respecting the central strip of the sixth and going to define the thickness of the edges. After defining also the outline I step to digging the channel along the entire perimeter. This channel, made with appropriate radius gouges, initially has a width from the edge and a curvature radius of about 11/12 mm for the upper and lower bouts and 6/7 mm for the C bout, both for the top and for the back. The minimum thickness within the channel is about 3 mm in the upper and lower bouts up to the corner blocks to then increasing in C bout up to 3.2 / 3.3 mm in the top plate and up to 3.4 / 3, 5 mm in the back. It is important to ensure that the minimum thickness of the channel remains just inside the corner blocks to make these areas sufficiently elastic, the "8" shape of the channel of the classic Cremonese archings achieves this purpose perfectly, ensuring the necessary flexibility of these areas.

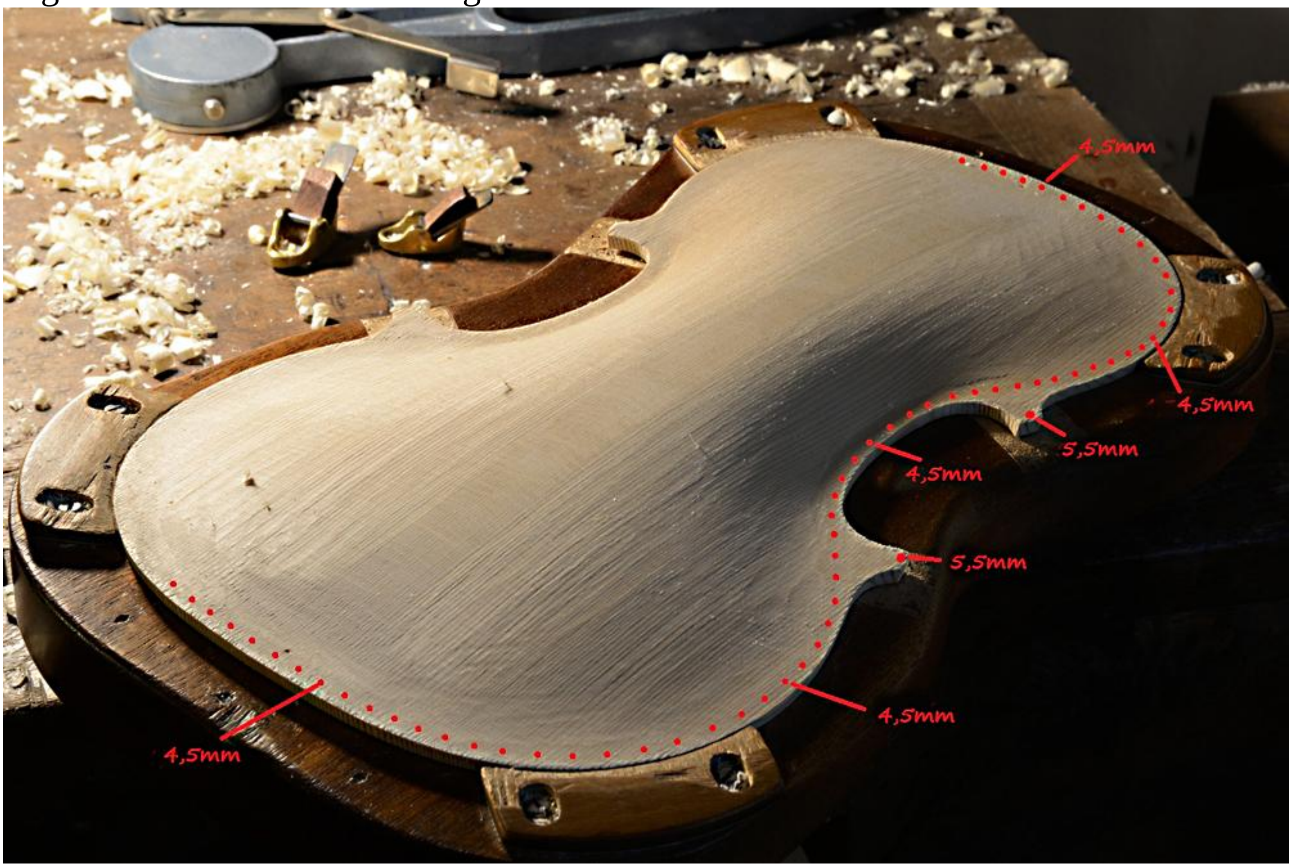
Back roughed with toothed blade fingerplane

Top roughed with fingerplane

Fingerplanes with normal blade for the top plate

Fingerplanes with toothed blade for the back plate

Edge thicknesses before making the channel



Gouges for the channel and marking gauge to mark the widths of the channel

Fluting channel

Fluting channel of the back

Fluting channel of the top

At this point, after purfling the plates, I make the connection of this channel blending it with the rest of the arching. This will determine the actual extension of the concave area of the channel and the transition point with the convex area of the central part, which plays a crucial role in the shape and elasticity of the arching. In the C bout, the extension of the channel must be minimal to provide greater resistance to the central

cross arch, while in the upper and lower bouts it may take a wider extension especially in the area of the corner blocks to ensure the necessary elasticity.
The curve change point is highlighted by the path of the first contour line, where the height returns to be equal to that of the edge (4.5 mm).

Blending of the fluting channel on the back

Blending of the fluting channel on the top

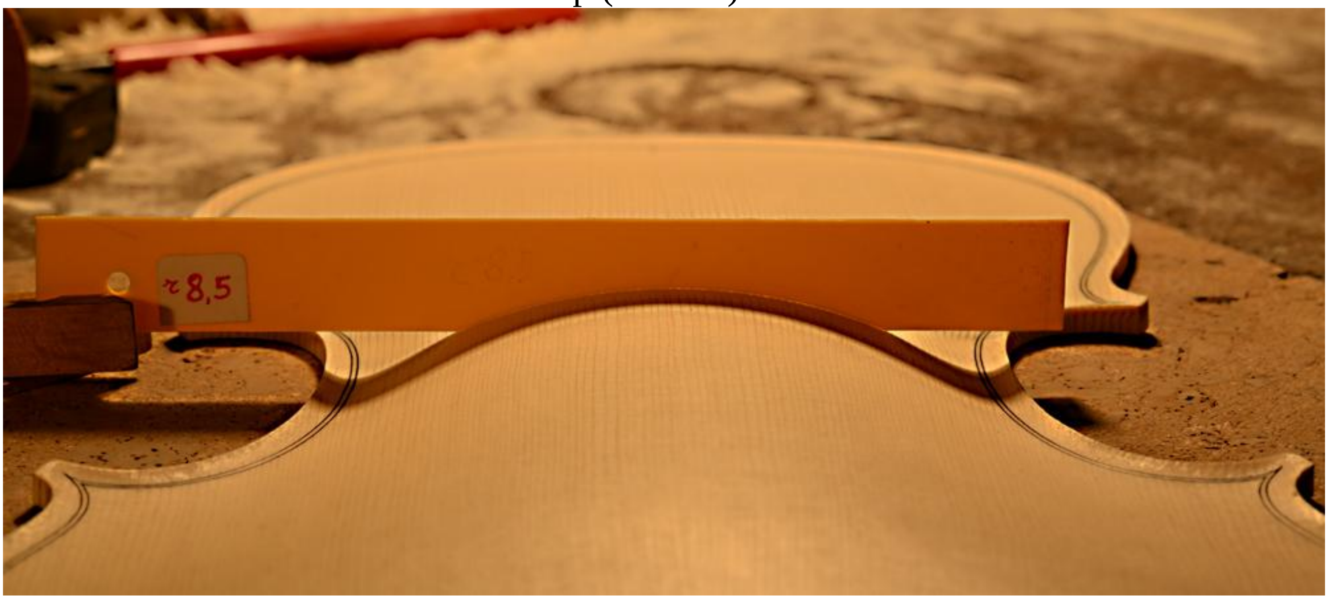
Drawing of the first contour line (4.5 mm high)

<u>The fifths</u>

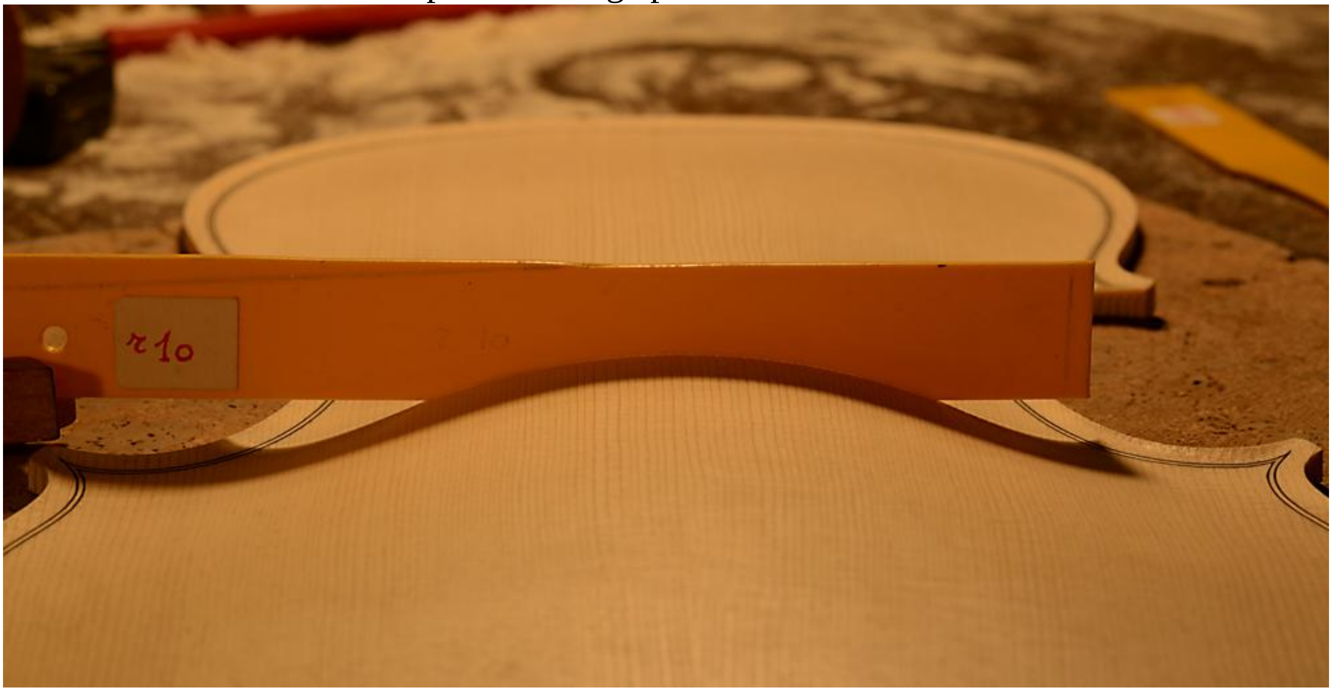
I do not use templates of the cross sections (fifths), but only a few simple circle arc temples with different rays to set the central curve of the arching. By connecting this circle arc to the opposite of the channel with a more or less straight line and varying the arch rays, variable cross sections can be obtained that will adapt to any difference in the height and radius of the archings and the extension of the channel.
By analyzing the cross curves of arching in ancient Cremonese instruments I realized that the radius of central transverse arc (the one with the minimum radius of curvature) is often very curved and in many cases is less than 8.5 cm radius in both top and back plates, thus ensuring an arching structure with rather obvious longitudinal resistance. The extension of this arc is limited to the central area for a width of not more than 7 cm to allow a fluid blending with the channel. I usually prefer a radius of 8.2 cm for the back and 8.5 mm for the top with arching height of 16 / 16.5 mm; in the case of lower and flatter archings these radii can also reach more than 10 cm but the longitudinal resistance will inevitably be reduced, making different constructive choices necessary to compensate for this loss of resistance.
Using a profile gauge you will always be able to draw all cross sections of the arching to compare them with any reference drawing.

Arc-shaped templates with various radii of curvature

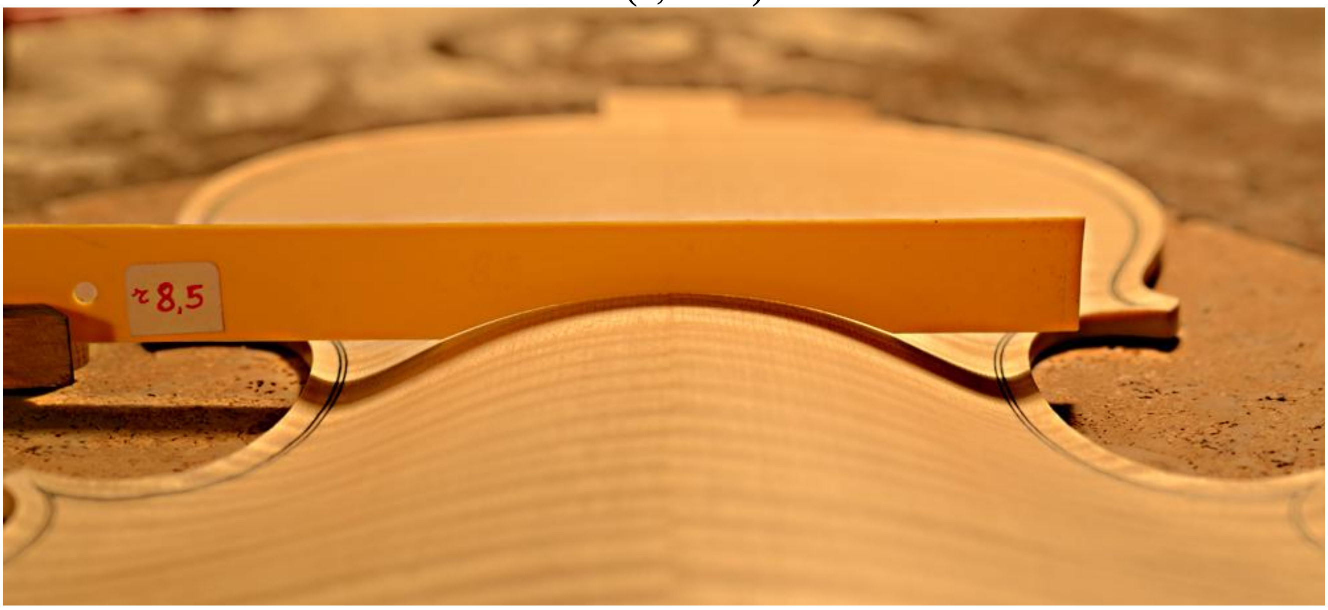
Minimum radius of curvature of the top (8.5 mm)



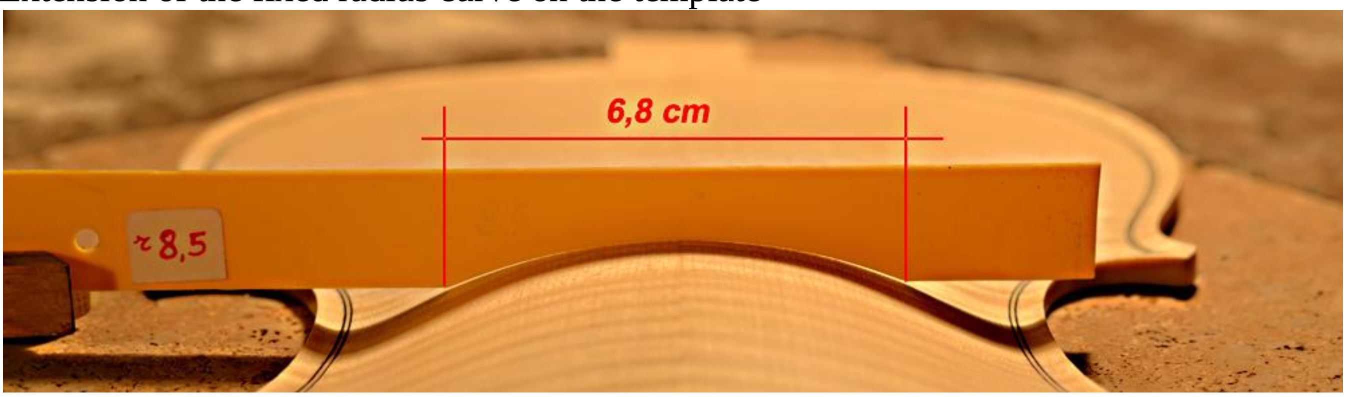
Radius of curvature of the top at the bridge position



Minimum radius of curvature of the back (8,2 mm)



Extension of the fixed radius curve on the template

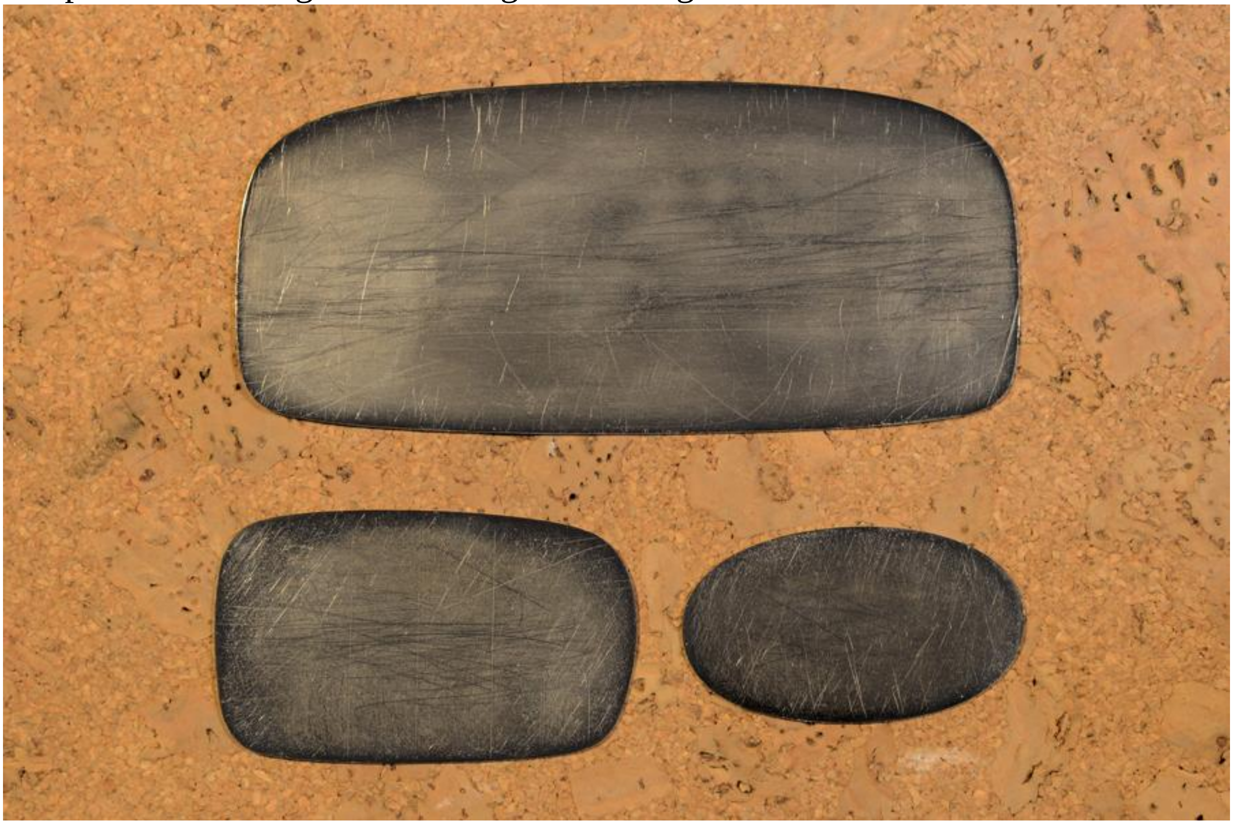


Profile gauge

A useful help in evaluating the symmetry, volume and longitudinal pattern of the arching is to trace the contour lines but the visual observation (by eye) of shapes and harmony of the curves using oblique light and looking at shadows is the most effective and irreplaceable evaluation system. For the final finishing of the arching shapes I only use the scraper, so that the curves can be changed very gradually, while obtaining an optimal and definitive finish of the surfaces.

Marking gauges to draw contour lines

Scrapers for working and finishing the archings



Working with scraper

Top plate contour lines

Finished top plate arching

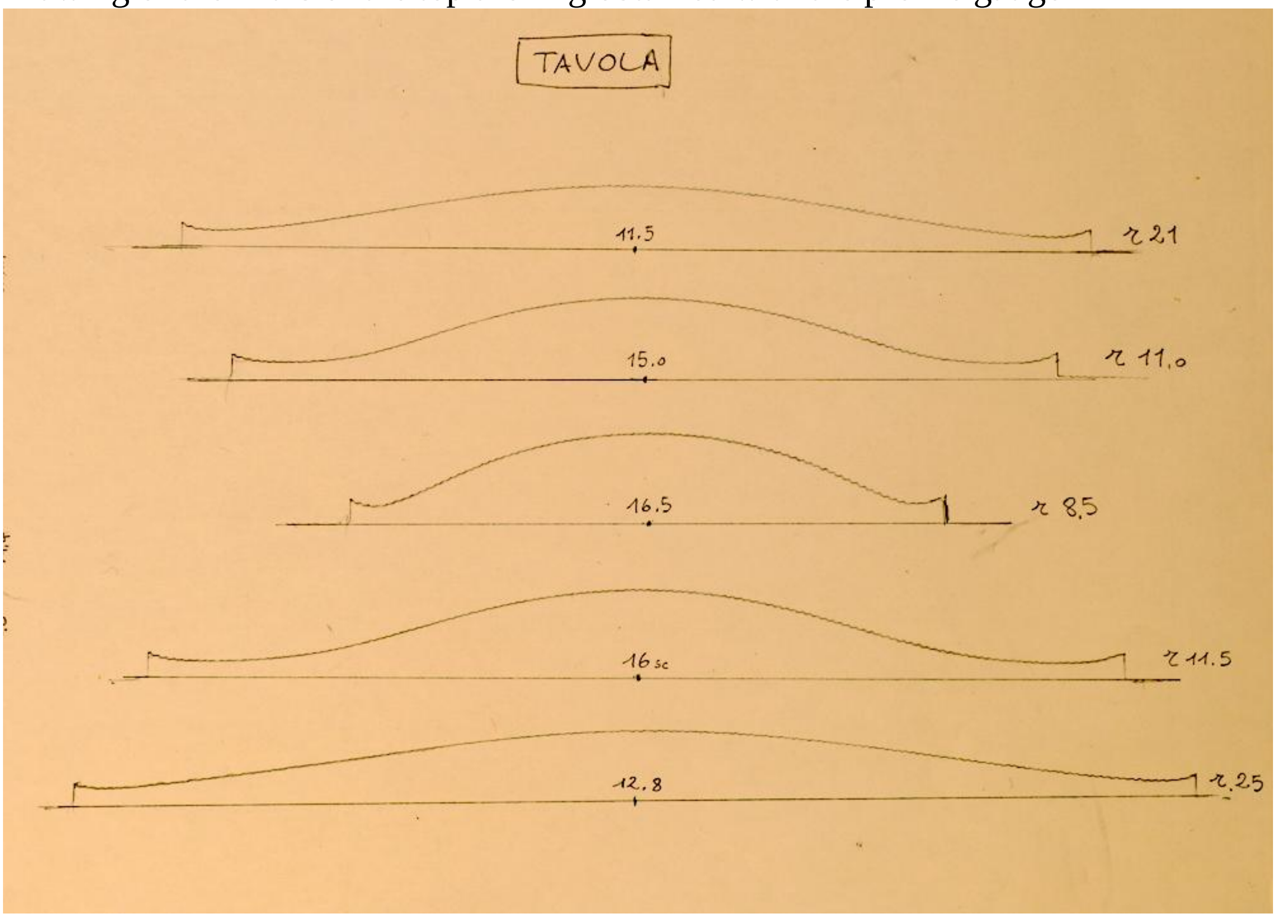
Finished back plate arching

Concluding

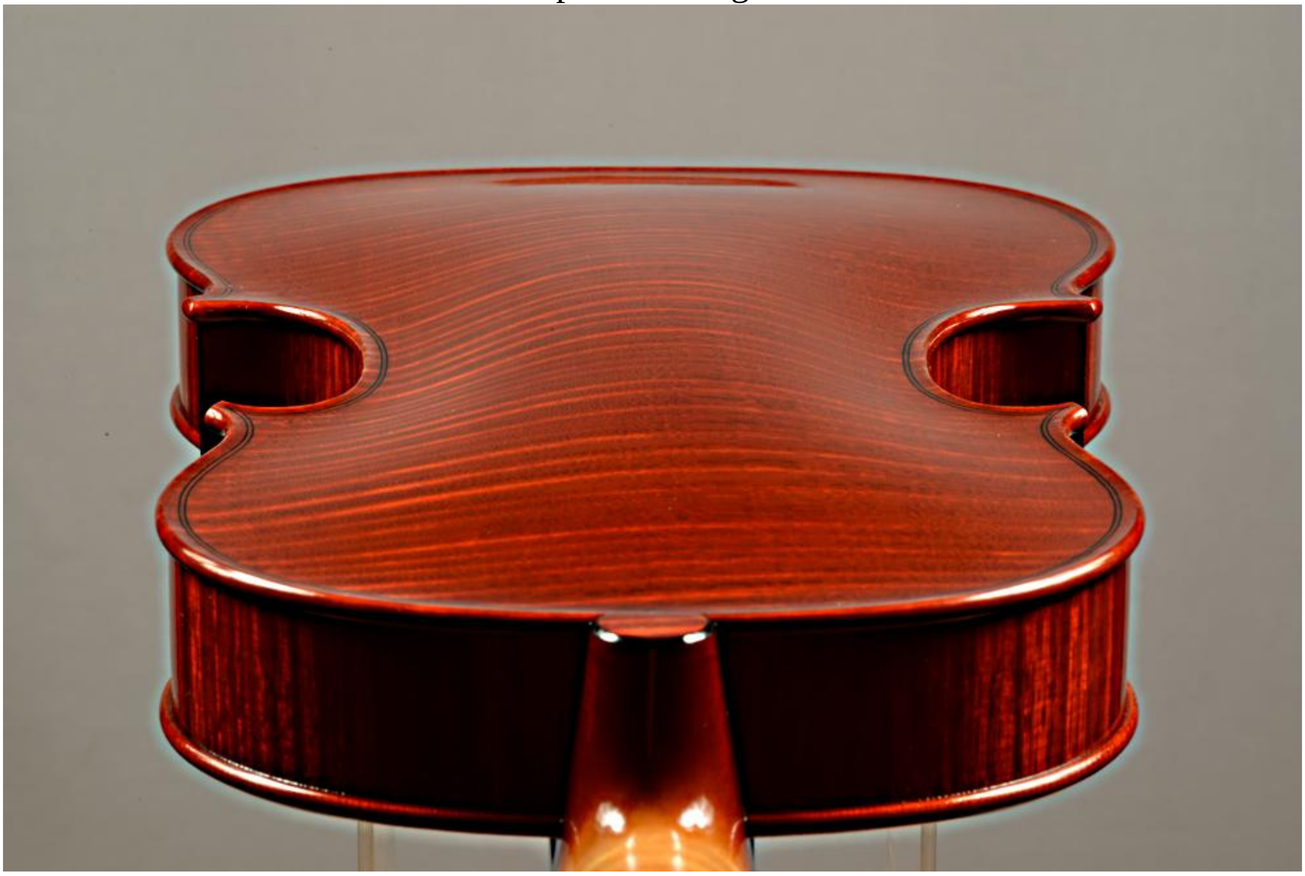
Concluding, one could say that it would be nice to be able to rely on a "standard" arching model to ensure an optimal sound and structure that last for centuries. Instead, in my opinion, one of the most fascinating aspects of this work is precisely the "necessity" of studying and researching, starting from a valid model, to produce a instrument that also reflects the taste and personality of those who have built it. Also, I think it is very important for the growth and evolution of the violin maker, to keep researching and dealing with the work of other violin makers: you can always "steal" something that allows you to improves or simply changes some details of your work. Among the instruments that I've built up to now, the one that, in my opinion , best expresses my type of work and the kind of sound I prefer is the violin that participated in the *Triennale Internazional*e of Cremona in 2015 that received the award offered from the "Polish Union of Artist Violinmakers" for the violin with the highest acoustic quality. This recognition is certainly not a point of arrival but a stimulus to keep researching and studying. For those who are interested, on the website **www.davidesora.altervista.org/videos/** you can find my videos that show my way of working in the different phases of violin construction.

Violin G XXI 2015 Triennale - Top plate arching

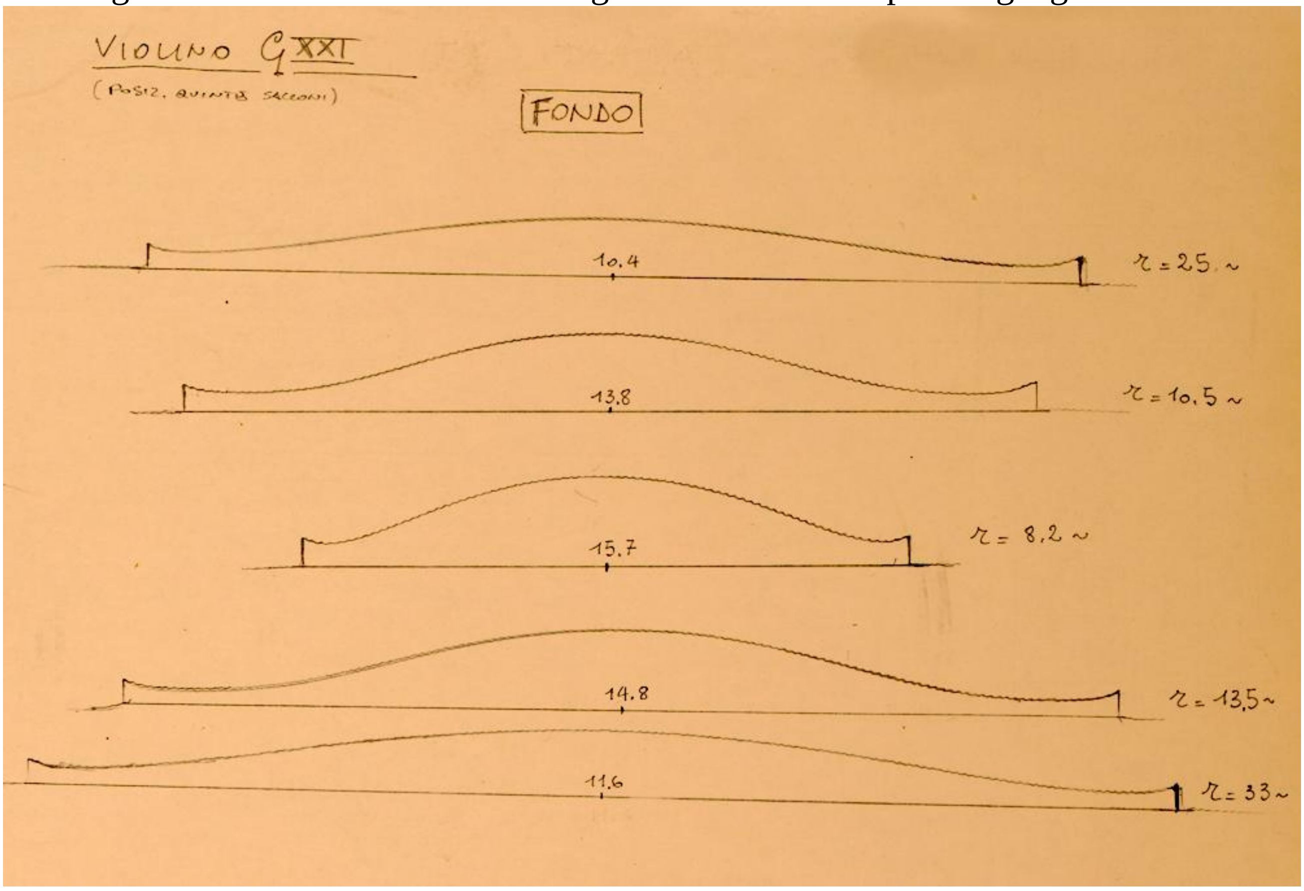
Drawing of the fifths of the top arching obtained with the profile gauge



Violin G XXI 2015 Triennale - Back plate arching



Drawing of the fifths of the back arching obtained with the profile gauge



Violin G XXI 2015 Triennale

Violin G XXI 2015 Triennale

Overall drawing of the fifths and sixths obtained with the profile gauge