

# Making Authentic 1st Century Calcei

<http://www.legiotricesima.org/campusMartis/makingCalcei/makingcalcei.html>

As a departure from the making of caligae, this page describes my attempt at making calcei requiring a last. Calcei are boots that are closed about the toe. This page shows the construction of a style of boot that was used up at least the end of the first century AD, contemporary with caligae. Some descriptions of these indicate a construction from goatskin. I made my first pair of these from goatskin and found the material rather fragile, as a consequence I've made the uppers from 4oz cow leather. These boots are sewn along the side and have straps going up the ankle. Under the straps there is a tongue and there is also evidence of a lining. As they are shown on statues of roman equestrians, these are either cavalry or officers boots.

For 2nd and 3rd century calcei, see the excellent site of Florentius:

[Calcei Florentii](#)

Unlike for caligae, these boots need to be made on lasts:



To make the lasts start with making a pair of patterns, one having the shape of the sole and a second showing the side profile:



It is informative to compare the sole shapes of caliga, on the left, and calceus, on the right. The caliga sole is much narrower.



The last construction begins by cutting sole shaped sections from 1x6 pine and glueing them together into stacks. Check with a square that the stack is straight up and down:



Next mark the side profile and rough-out the profile using a band saw:

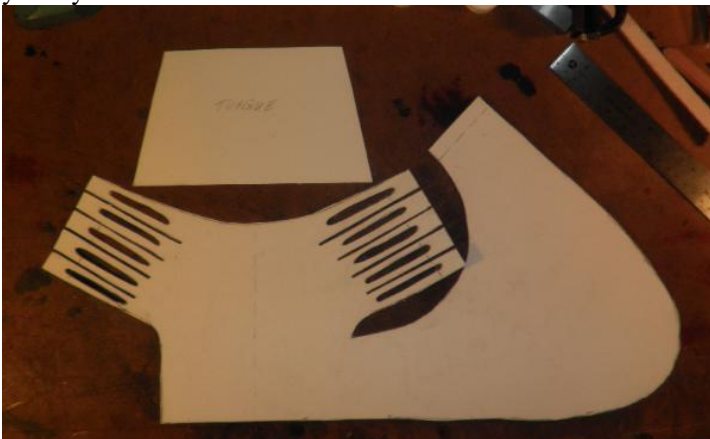


The lasts are then shaped. Before starting, mark the peak line on each last. I start out using a disc sander, followed by wood rasps, and lastly hand sanding. Any dips may be filled with auto body putty.



Now we can draw the pattern for the uppers. To do this I wrapped the uppers in masking tape, overlapping the tape by half, first going longitudinally and then vertically. I cut the tape on the bottom for a 3/4 inch lasting margin.

The cut-outs of the boot are marked on the tape and then the tape is cut with a knife and peeled off. Upon laying the tape flat the tape will distort somewhat. Add a little bit to compensate. Be careful not to add additional distortion to the tape when you lay it out.





The resulting pattern for the upper and for the tongue. The tongue curves around the top of the vamp. Now we can begin making the boot itself. Start the upper assembly by stitching on the tongues and gluing on the heel stiffeners. Check the pattern by making wrapping the last in fabric. I used some red felt that I had laying around.





The heel stiffeners need to be skived along both the top and bottom edges.

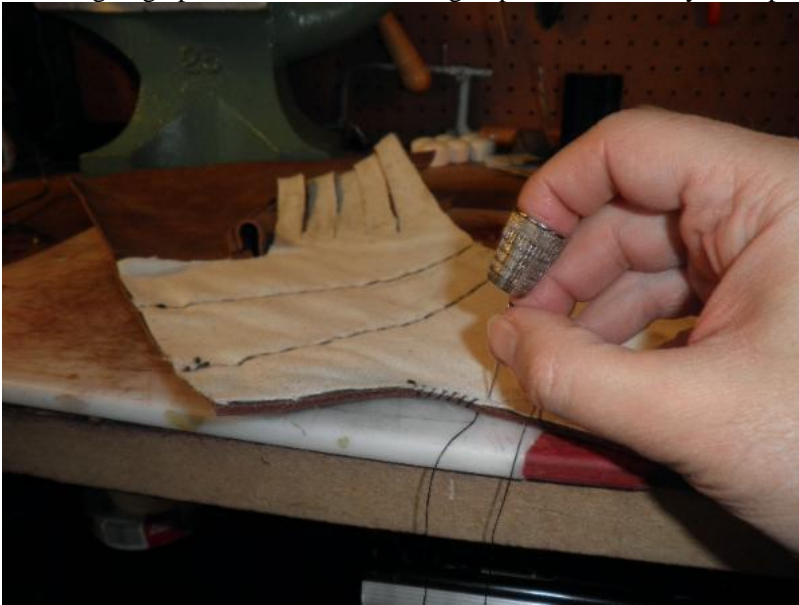


The partially assembled uppers need to be oiled prior to stitching on the fabric lining.



After the oil has dried it is time to stitch on the lining. It is known that the boots from Germany had a lining on the back half of the boot from stitch holes, I'm not sure about those from Egypt, previously unpublished photos of the Egyptian boots are in Graham Sumner's book, "Roman Military Dress", and unlike the boots from Mainz, those from Qasr Ibrim do not clearly show the stitch holes for the lining, their construction is otherwise identical.

I used some wool flannel left over from my toga. Start by gluing the fabric to the ankle straps using white glue. Two diagonal stitches going up the back hold the lining in place followed by a whip stitch along the edge.



It is a lot of work to do all of the sewing, but the result is quite pleasing:



A half inch over-lap was built into the pattern to allow the upper to be stitched together. Judging from photos, I stitched the upper together 2.5 inches from the back and 1.5 inches high from the sole. I then cut away sufficient material from the vamp to permit a one inch tab length (this was built into the pattern). These dimensions affect the appearance of the boot. A double column of stitches finishes the upper:



After the uppers are done comes lasting. First soak the upper in hot water from the tap over night. Putting the upper onto the last I followed the approach of Tim Skyrme, see his book, "[Bespoke Shoemaking](#)", of temporary nailing the back of the upper 10mm above the bottom the last. After nailing the insole to the bottom of the last, you then start with the toe and work your way back from the toe pulling with lasting pliers on alternate sides of the upper. The initial lasting looks like this:



Besides pulling the upper over the insole, the lasting pliers are used to pound in the nails:



I then worked on the back followed by the toe, while making sure that the back was kept centered and the boot height was as desired. Some excess material at the toe may be cut away.





The upper on the last:



Having arranged the upper on the last, the next step is to sew the upper to the insole. The zig-zag tunnel stitch of the upper to the insole that I use here is illustrated in the chapter on roman footwear in the book "Stepping through time". To accomplish this a curved awl is needed to make the tunnels for the tunnel stitches followed by the use of a flexible steel needle to do the actual sewing. Do not waste your money by purchasing an actual curved awl, they're expensive and you'll break it. Rather, buy a bunch of curved suture needles. Cut off about an inch of the shank and chuck the remainder into an awl holder. Tandy Leather sells a suitable holder. Here I am making a tunnel for an insole to upper stitch:



The romans would of most likely used a boar's bristle to sew the tunnel stitches. I have no idea where to obtain these so as an alternative I use a flexible steel needle. These are sold as beeding needles in craft stores. Buy the ones that consist of



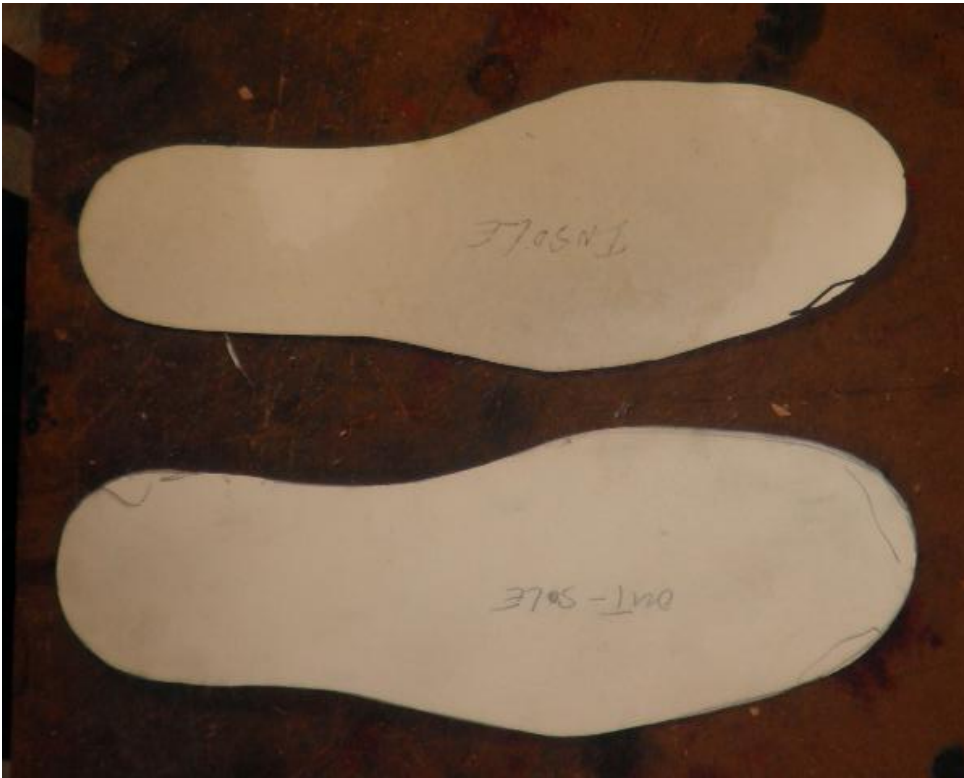
two pieces of fine wire soldered together at each end. The process is quite simple, make the tunnel with the curved awl followed by passing the thread through by means of the flexible needle.



The finished result:



The next step is to attach the out-sole. First, before removing the last, make a template for the out-sole. It needs to be a bit larger than the insole.



The out-sole itself is cut from [bends](#), hardened and compressed leather. To attach the out-soles I stitch them on using a tunnel stitch running around the boot offset from the edge by 1/4 inch. In the back of the boot I stitch right through the insole to give me access to the thread so that I may more readily tighten it. I was going to simply glue the out-soles to the uppers, this works for some, but short-cuts seem to fail me. I was not happy with the secureness of gluing.

This also a good time to add the lacing. Make a pair of holes at the top of the vamp for the lace to pass through and then thread the lace through the straps. I've had problems with laces breaking. Currently I am using [9/64 inch square latigo lace](#) that seems to be strong enough.

Before doing the stitching I glue on a couple of pieces of leather to partially fill-in the gaps caused by the lasting margin. This should prevent a future caving-in of the of the out-sole.



After soaking the out-sole in hot tap water over night, I make the tunnels every 1/2 inch:



As can be seen above, starting from the back of the boot, I use the flexible steel needle again to pass the thread through a tunnel in the out-sole, up through the insole, and down through the insole. Around the closed part of the boot, as I cannot see the holes, I pass the thread through a tunnel passed through the upper. Several iterations of tightening are necessary to secure the out-sole in place. See my [caligae page](#) for a more pictures showing the method in progress.

Next comes the application of the hobnails. I'm using the Ketica style nails made by DSC. To effectively apply them to the out-sole, nail them in straight, these require a bit of extra work. Used as they come these nails have a tendency to bend upon impact with the anvil. To insure more consistent results I drill a 1/16 inch starting hole in the leather and file the shank of each nail to form a long tapered pyramid. The following photos show before and after the process of filing:







Nailing proceeds by placing the boot on a specially made shoemaker's anvil, laying out the nailing pattern in pencil, and carefully pounding in the nails. The shanks of the nails are just long enough to mushroom out upon hitting the anvil surface.



The finished result shows the circular gap located in the vicinity of the arch of the foot. This is copied from a roman nailing pattern.



The only thing left to do is to glue-in a thin leather sole shaped layer on top of the insole. The finished boot:



On my foot, wearing a thick wool sock the fit seems to be ok. It looks like I got the last measurements correct. The strap lengths came out perfect.





The left boot is made just like the right boot, but on the left last. Here are both completed boots:



A note on preparing for sewing. I use waxed linen thread. To attach the needle to the thread I first pass the thread through the needle eye and then I pass the point of the needle through the thread itself. The resulting loop of thread is then pushed back over the eye, grasp the short end of the thread and pull tight. This makes a secure bound of the needle to the thread.





The fit seems to be good:



Here is a picture of the tools that I use to make calcei. The flat hobnailing anvil was custom made.  
Another shot, taken after having worn them for an entire day at Reenactor Fest Chicago:

