Curved Pieces are a Common Woodworking Challenge

I recently created a set of four dining chairs that required three curved back rest pieces each. On the top piece of each chair I wanted to inlay a marquetry picture of acorns and oak leaves. Each back rest piece was about7/8 inch thick by three inches by 15 inches.

Here you see the extent of the curve a bit better:

I could have found solid stock that was thick enough to allow me to use my bandsaw to cut the curves on both sides. This approach, however, has several problems. First, it is not easy to find oak thick enough to create a piece like this. Oak this thick would be very expensive and a lot of it would have been wasted. Second, I'm familiar with a technique called “double bevel marquetry” that requires thin stock (1/8 inch or thinner). By laminating seven 1/8 inch thick pieces of oak over a bending form, I was able to create a picture in one of the laminations resulting in a final effect that is difficult for most people to guess at how it was done.

Regardless of if you are trying your hand at inlay or marquetry as I did, many furniture projects require wide stock bent to a pleasing curve. Steam bending is another bending technique commonly used in furniture construction. Because of the inlay, however, steam bending was not a good choice for this project. For this project, bentwood lamination was the natural choice.

Everything Begins with a Master Template

I'm a big believer in taking the trouble to create an accurate pattern or template for any curved part of almost any project. I almost always make my patterns out of ½ in MDF. I find that MDF is an easy material to work with (particularly when fairing curves), is stable, and can be stored indefinitely in case you ever need to use it again. This master pattern or master template will only be used occasionally as all working patterns, templates, or forms are made from the master.

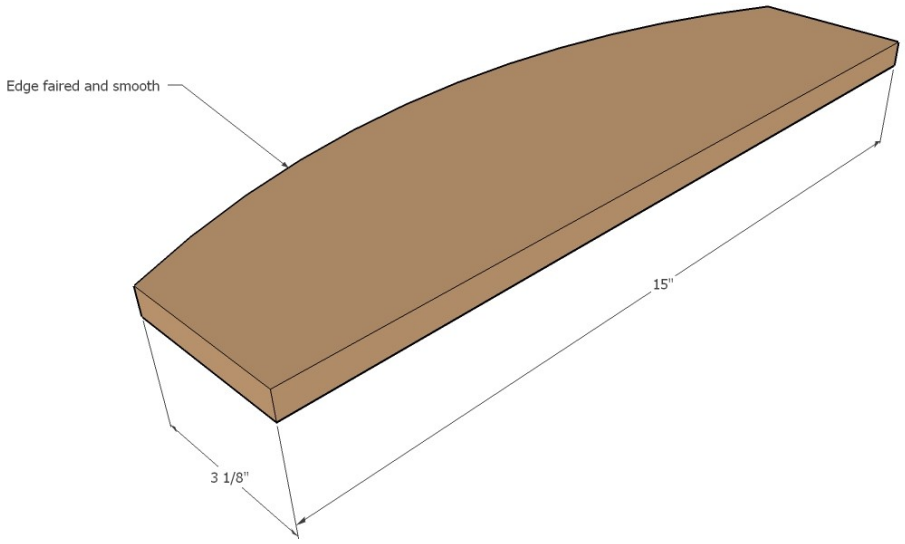


Illustration 1: Master Template

Illustration 1 shows an example of the master template I created to build the forms for the laminations for this project. I started out with a piece of ½ MDF ripped to exactly 15 inches and about 5 inches wide. I drew the curve in pencil and roughed out the curve on the bandsaw leaving the line and about 1/8 inch of material. I then used a disc sander, rasp, and flexible sanding block to smooth and fair the curve. I also like to use a permanent marker to write the name of the template and the project name so it will be easy to identify should I ever need it again in the future.

Types of Forms

There are basically two different ways you can build a form to use for bentwood lamination: open and closed. An open form is one where a single form is created and a series of holes are used to clamp the strips to the form.

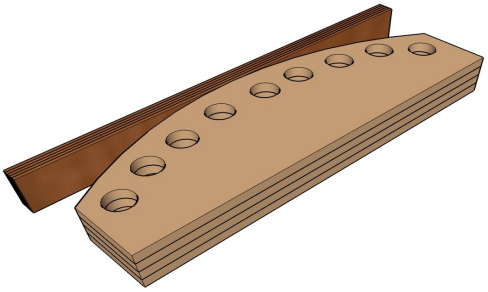
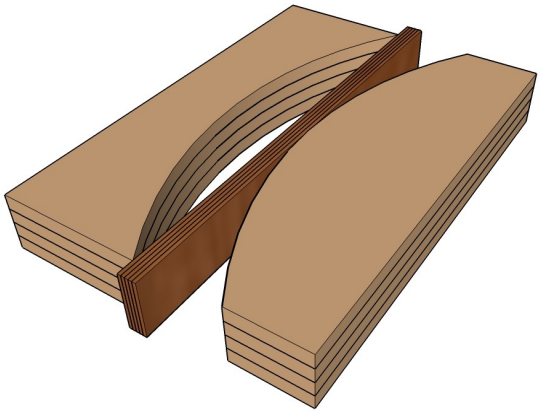


Illustration 2: Open Form Example

By starting with a clamp in the center and working toward the edges, it is possible to tightly clamp the laminations to the form. This technique works well if you are creating a complex shape with a couple of curves as you might if you were gluing up laminations to form the rockers for a rocking chair. The width of the material you can work with in a form of this type is another factor to consider. The open form works well for relatively narrow stock. For wider stock, you will need two clamps in each hole (top and bottom) to be sure you are applying even clamping pressure.

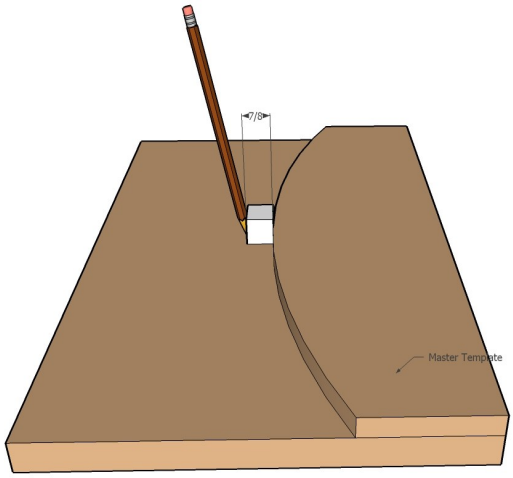
For the chairs I was making, I was gluing up laminations that were three inches wide so I opted instead to make a closed form. With a closed form, the laminations are clamped between two forms made as a mirror of each other but designed to compensate for the thickness of the material being clamped.



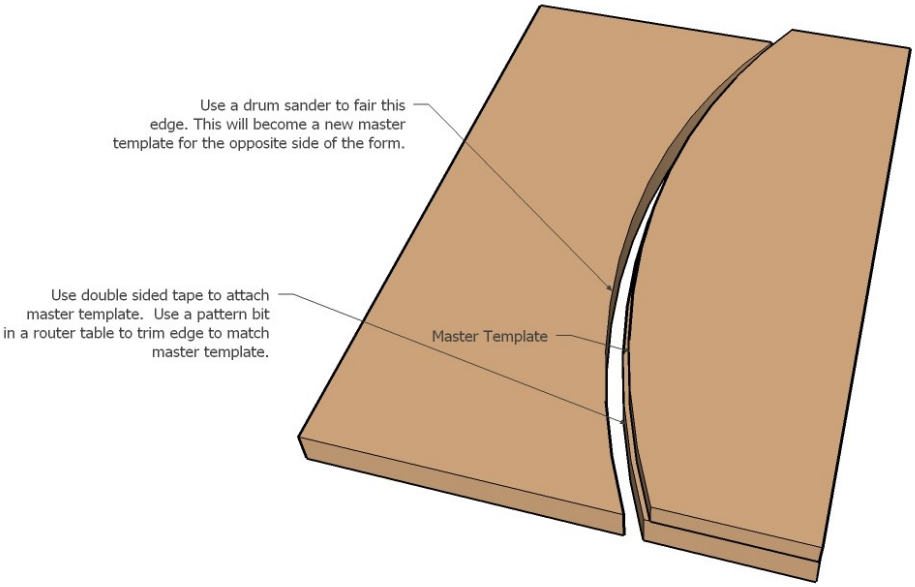
Making the Forms

The forms are straightforward to make if you have a router table with a pattern bit and some double sided tape. The master template can be used to layout both curves but we must be careful to take the thickness of the material being laminated into account. These two curves will be slightly different because they represent, in effect, a short segment from two different circles each with a slightly different diameter. It helps to imagine an inner circle representing the convex curve and an outer circle representing the concave curve. The difference between the radius of the two circles represents the thickness of the laminations. To create both forms start by placing the master template on a piece of ¾

in MDF cut to same width as the template and long enough to make both forms plus the thickness of the material.

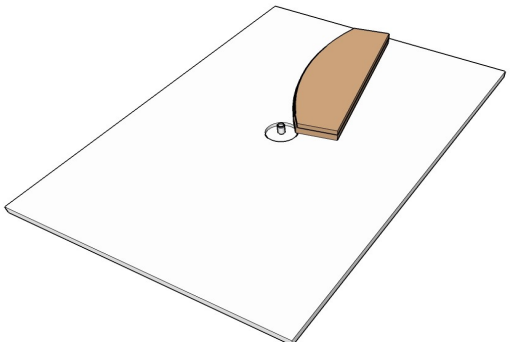


Use a pencil to draw both arcs, one using the master template as a guide and a second arc using a small block the thickness of the material being laminated to offset the second arc the correct distance. Using a bandsaw, cut both pieces leaving the line. The master template can be used along with a router table and a pattern bit to create the first part of the convex form.

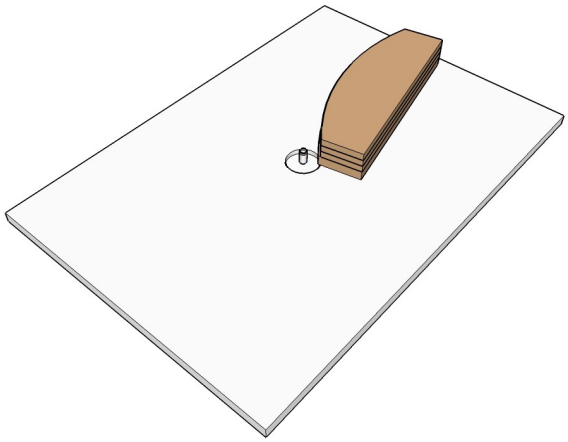


You now have two pieces of ¾ inch MDF that can be used as templates to create the actual form. Double stick tape the master template and use a router table with a pattern bit to create the first part of

the form:

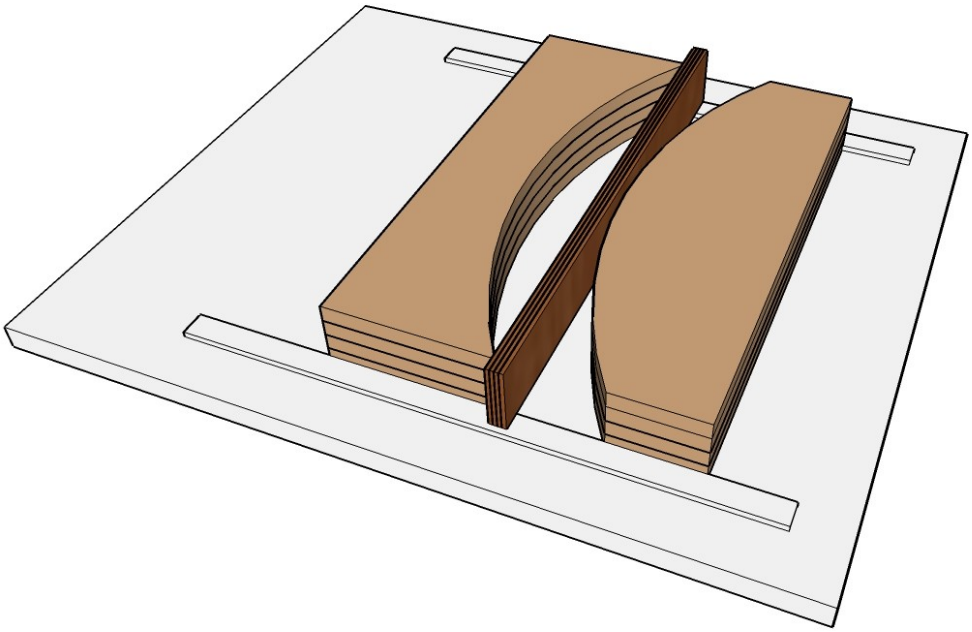


You have now created the first component of the form. Simply repeat the process but instead of using double stick tape, now glue and nail each subsequent component until you reach the desired thickness of the finished form.



It is important to cover the inside surfaces of both forms with clear packing tape. I take the time to completely cover both forms in packing tape to prevent any glue from sticking to the forms. If you wish, you can also cover the inside surface of one of the forms with thin cork before you cover the cork with packing tape. The cork will smooth out any minor imperfections in the forms and may help achieve a more uniform glue up.

One of the problems with a closed form is keeping the laminations properly centered in the forms and keeping both forms properly aligned as you apply clamping pressure. Some kind of capture system must be devised to keep both forms aligned as you bring them together with the laminations in the middle. If not, it will be difficult and perhaps impossible to get both forms to properly align. For the forms I made for this particular glue up, I used a scrap piece of melamine and a couple of hardwood strips to create a simple alignment system.



Preparing the Laminations

I needed seven 1/8 inch thick by 3 by about 17 inch long pieces of oak for each curved back rest. In theory, it is possible to rip stock this thin on the table saw, but I have never found a way to do this that I felt was even remotely safe. Other woodworks would certainly disagree and I'm sure that many woodworkers use the table saw routinely for this type of task. I happen to have a large bandsaw in the shop that I've dedicated to resawing stock. Since I do a lot of resawing for various reasons including making my own veneer, I naturally turned to my dedicated bandsaw to rip these pieces. I believe it is important when resawing on the bandsaw to have the face against the fence planed smooth. I keep a small jointer near the bandsaw and use the jointer to smooth the face each time I cut a lamination. I cut the laminations thicker than 1/8 by at least 1/16 inch. I will then place the smooth side of the lamination down and run the piece through my drum sander to get the stock to 1/8 inch thick and smooth on both sides.

Laminating Requires a Rigid Glue

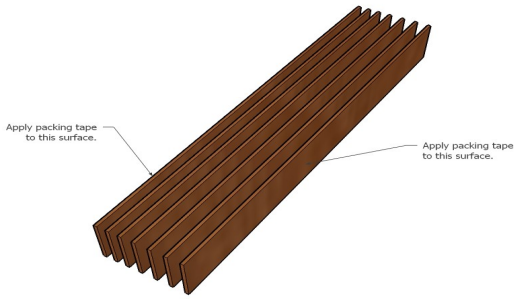
Bending a hardwood like oak in a form and having the resulting glued up lamination retain the shape of the form requires a glue that is absolutely rigid. The yellow or white glues commonly used in woodworking do not form an absolutely rigid glue line. This means that a tiny amount of slip will occur as the forms are released resulting in the lamination springing back some amount. The amount of

spring back is difficult to predict and worse still may be inconsistent from lamination to lamination.

A second problem to contend with when creating glued up laminations is that many woodworking glues setup so fast that it will be difficult for you to get glue on all the surfaces before the glue starts to setup. This can be a real problem if you are making long laminations that involve compound curves where the time it takes to draw the forms together with clamps adds to the time it takes to get the glue on in the first place. Using a glue with a short setup time can add a great deal of stress to the entire process and could result in outright failure of the glue joint.

I have found that Unibond 800 urea resin formaldehyde glue is the perfect glue for this type of application. It forms an extremely rigid glue line that greatly minimizes spring back and depending upon room temperature, has an open assembly time of from 10 to 30 minutes. This glue is a two part glue where one part is a translucent liquid resin and the other part is a powdered catalyst. It must be mixed just prior to use and once mixed immediately begins to catalyze. You can increase the open time by making minor adjustments in the amount of catalyst you add to the liquid resin. This glue is not commonly available and I've only found it over the Internet.

One final bit of advise is that this glue is extremely difficult to remove and should be handled only while you are wearing latex gloves. I strongly suggest you protect any wood surfaces in your glue up that will eventually be visible with tape. I have found that clear packing tape works perfectly and for the curved back rests I applied this tape to these surfaces:



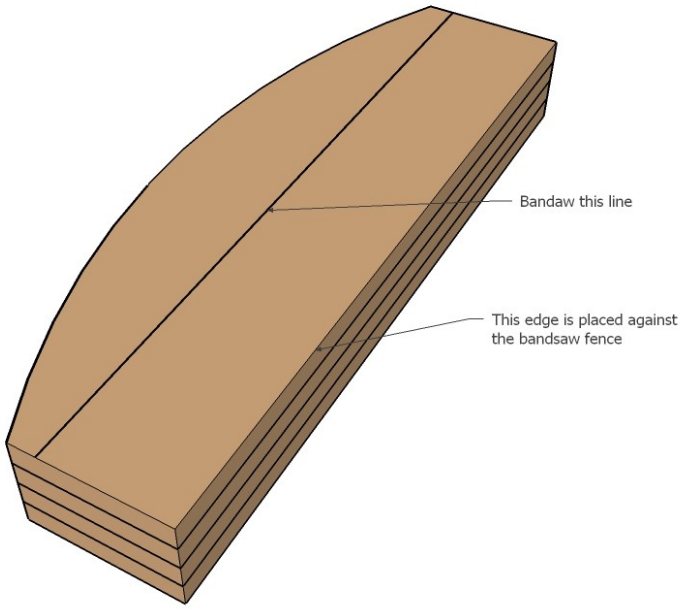
Cleaning up and Trimming the Curved Lamination.

After the glue has cured and the lamination removed from the form, the glue squeeze out must be removed and the piece cut to final width. The first step is to use a paint scraper to remove most of the glue squeeze out from one edge, then run that edge on the jointer to smooth it out. You can easily run a curved piece of stock over the jointer as long as you are careful to keep the piece tightly against the fence as you move it through the jointer. After one edge is jointed smooth, you can cut the piece to final width using the bandsaw, again by keeping the jointed edge against the bandsaw fence as you move the piece through the sawblade keeping as much of the curved piece on the table as you can. This harder to describe than it is to actually do.

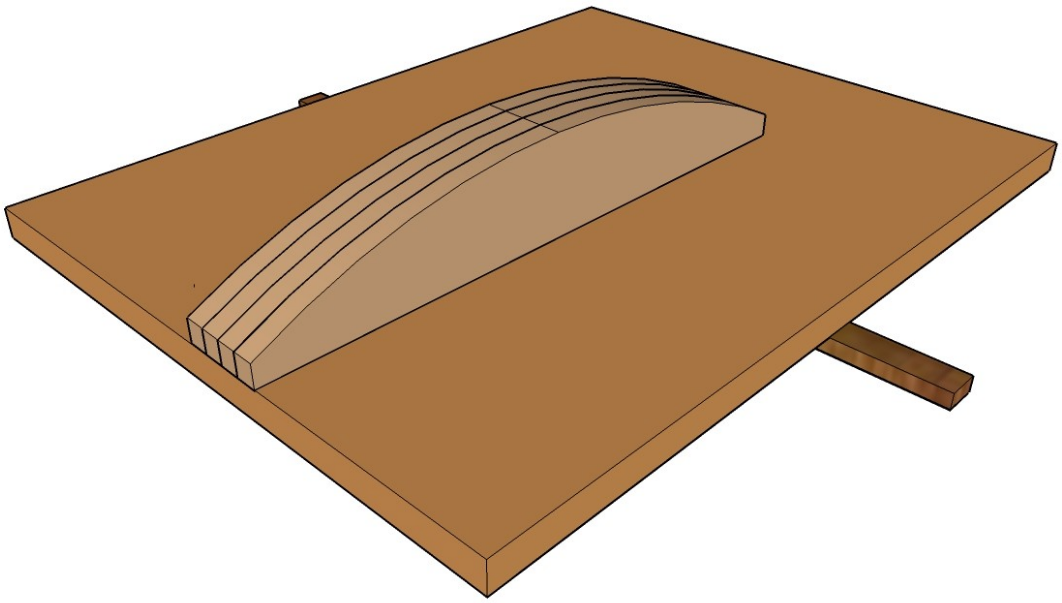
For the curved backrests to fit properly in the chair back, both ends must be trimmed square on the

table saw. This is impossible to do without creating a fixture to hold the piece securely as it is passed through the sawblade. I again turned to my master template, this time to create a sled for the table saw to hold the curved work perpendicular to the blade. I created the master template to be the exact width I wanted the finished curved pieces to be. When cut the oak to make the laminations, I cut them longer than this final width intending to trim and square the ends later.

The first step is to use the master template to create what amounts to another half of the closed form and use the bandsaw to then rip the form as shown below:



The curved piece is then used to create a trimming sled as shown below:



The trimming sled will be used to trim each curved lamination. Since I used the master template to create the form on which the lamination will rest, it is possible to use the form itself to be sure that the curve is cut to the exact width (15 inches) and that the edges of the lamination will be in the correct plane.

Creating Curved Backrests using Bentwood Lamination.

LARRY CIESLA WOODWORKING