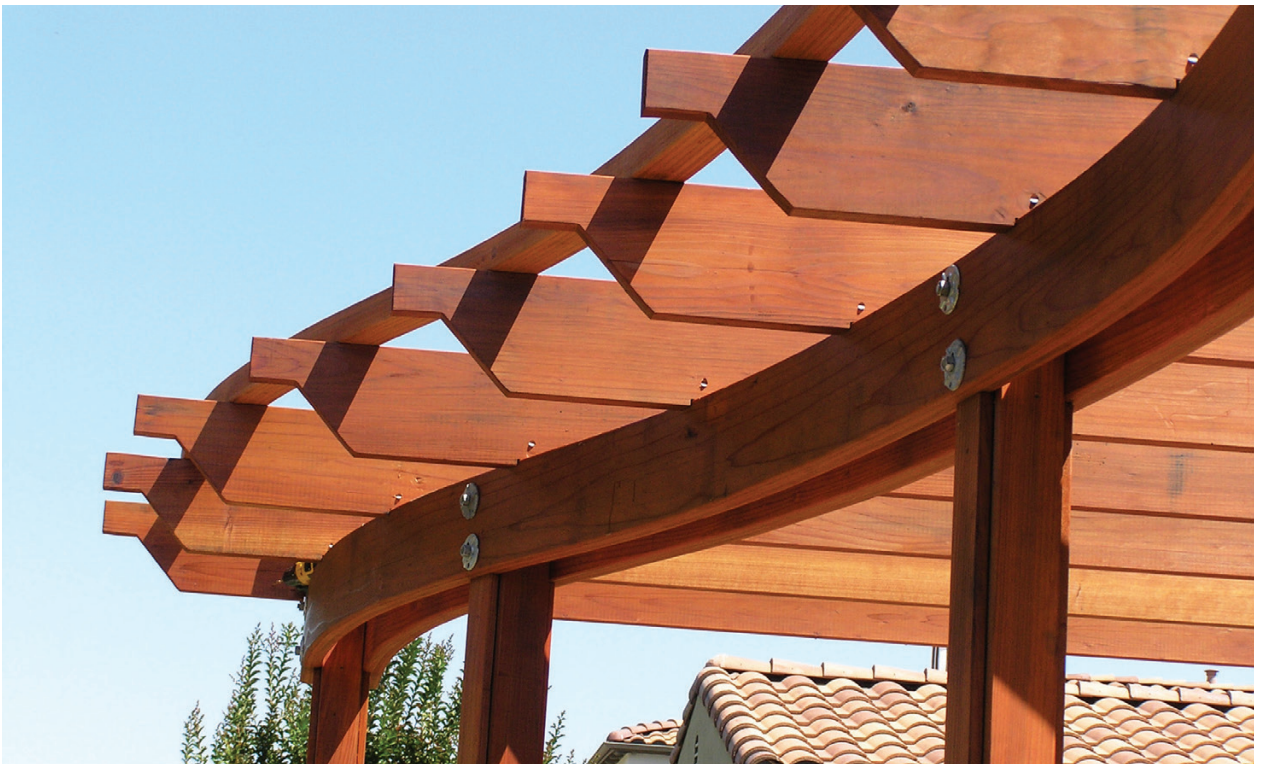
Adding Curves to a Redwood Trellis

by Mark Ellis



PHOTOS BY MARK ELLIS

Over my 40 years as a carpentry contractor, I've been lucky enough to do some creative deck projects, some of which included curves. I think that incorporating curves into their projects scares off more than a few contractors. Me? I get excited.

There are many ways to introduce curves into an outdoor project. Probably the most straightforward is to simply create and install curved braces, instead of using angled pieces of solid straight lumber. The easiest way to do that is to cut the curved braces out of large, solid timbers, but finding quality material with the dimensions required is often both difficult and costly. In addition, you need to have the equipment and skill to make accurate cuts on sometimes thick material, and there is usually a lot of waste.

More times than not, the task requires laminating thin pieces of material together around some sort of form to create the curved shape. This is not as difficult as you might think.

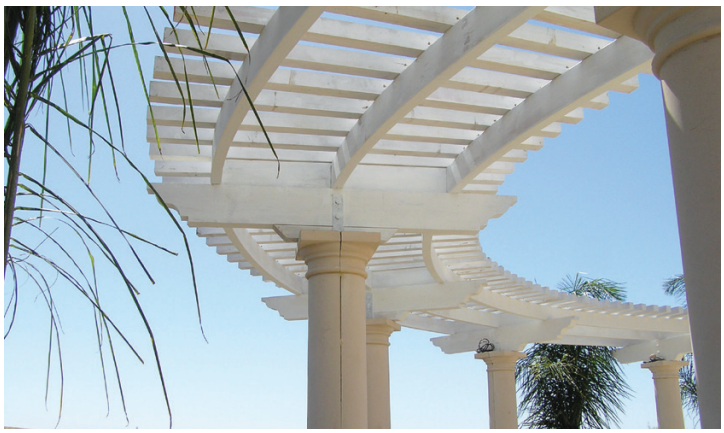
Design

On a more complex design, it helps if you have a CAD software program—or the ability to use SketchUp—that will enable you to draw parts to scale. I started with DataCad and then moved up to Chief Architect. Most CAD programs can tell you the radius and the length of the pieces required to make your parts. What the programs cannot tell you, however, is how thin the material will need to be for you to bend it to the required radius.

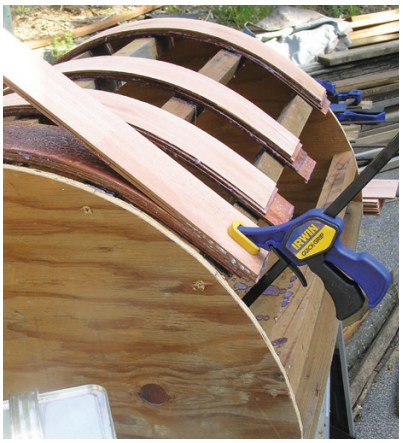
I'm sure there are mathematical equations and material-property charts for different wood species that can be used to determine the proper lamination thickness for a particular radius curve, but most of us probably do not possess that skill set—I know I don't. My approach was trial and error at first, and eventually, from experience, I gained a good idea of how thin pieces would need to be to form certain curved shapes. Basically, the lamination thickness is determined by the curve radius, the type of wood, and your own strength. Logically, you would like these pieces to be as thick as possible and still do the job, because using fewer laminations saves time.

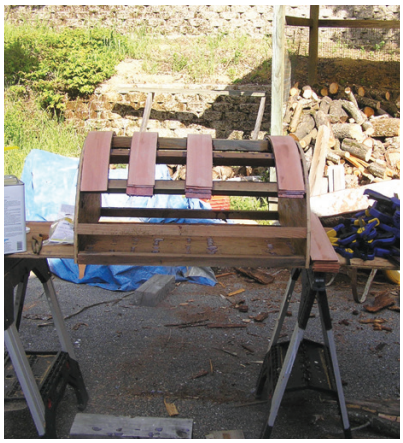
Forms

Once you have determined the shape you want to make, you'll need to create



These arched subrails (above left) and sweeping pergola rafters (above right) are just two examples of how the author has incorporated curved laminations into his projects. Learning to glue together multiple thin layers of wood while bending the glued layers around a curved form is the key to making these elegant architectural details.





To laminate curved braces (similar to the arched subrails in the photo at top left), the author assembles plywood forms with 2-by stringers connecting the sides (above left). The stringers provide plenty of room for the multiple clamps needed to bend the laminations (above center). After the epoxy adhesive has cured, the clamps are removed (above right).

a form to bend the laminations around. The form can be simple or it can be more involved, depending upon the shape and size of the pieces.

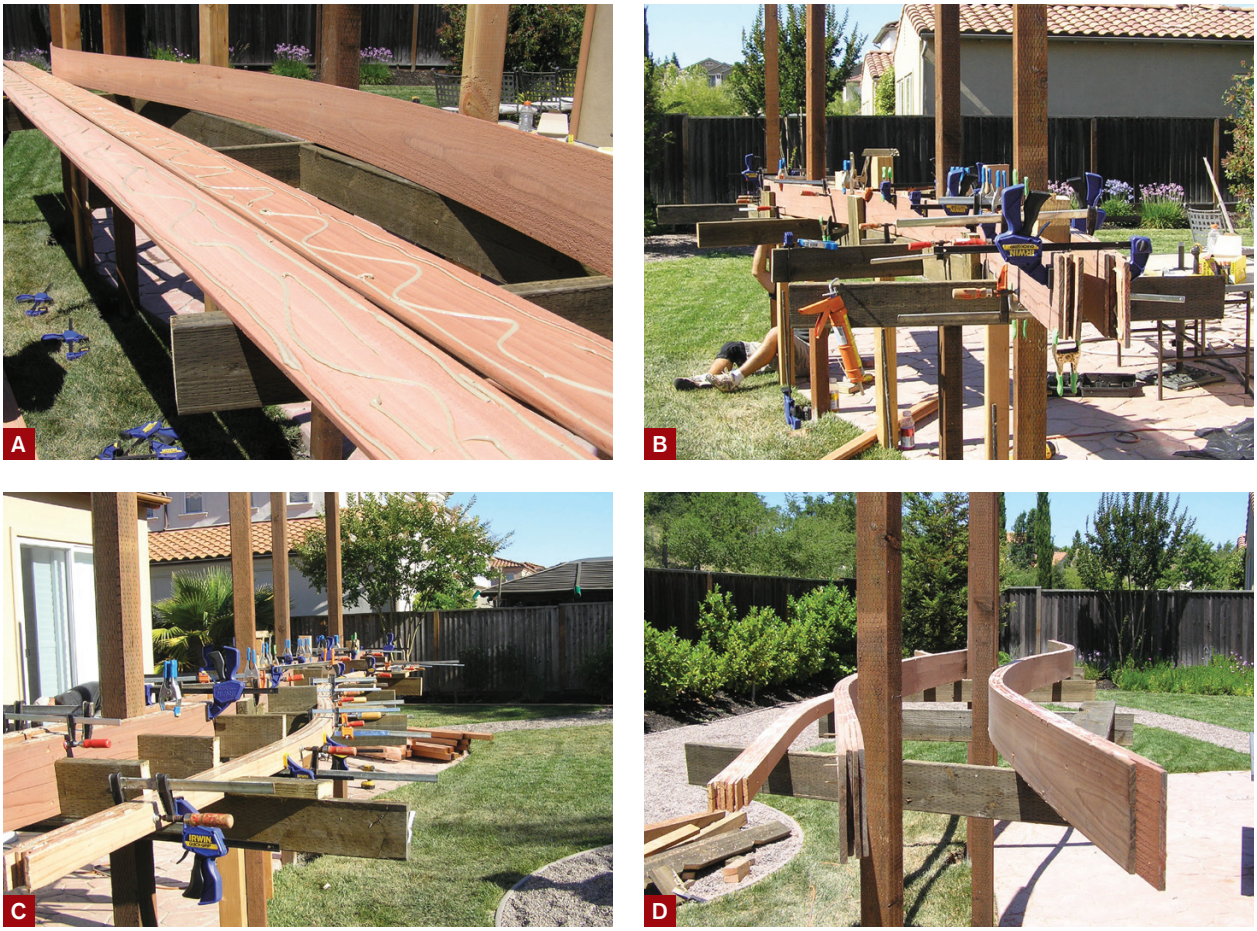
One thing to note is that usually a glued-up lamination will spring back a little towards its natural shape once the form that is being used to hold it to its new shape has been removed. In practice, this is mainly a problem when using fewer laminations; the more laminations there are in an assembly, the less that springback occurs. Once again, experience will be your guide, and—depending on the shape of the curve—often you can discount springback entirely. In other cases, you may need to "overbend" the lamination to account for springback.

For braces, I usually cut two pieces of ½-inch plywood with the desired inside radius of my curve. Then I connect the two pieces of plywood with intermediate pieces of 2-by material, flush with the top of the radius. The number of connecting pieces that will be needed is determined by how tight the radius is and how long the curve is. The more connectors there are, the more precise the curve will be.

Glue-up

Laminating material, especially for tighter radii, should be reasonably free of knots and preferably have a vertical grain. Most adhesives will work better with drier material, which unfortunately doesn't bend as easily.

At this point, if you haven't determined the thickness of the laminating strips, you can figure it out using trial and error. Start by ripping the material to the thickest piece that you think might be able to bend to the radius you are working with. I have a 14-inch band saw with a maximum cutting height of 6 inches that I can



To make the long curved beams and stringer for the redwood pergola featured in this article, the author started with thin stock sourced from a local lumberyard (A). He screwed the first layer to the pergola's support posts, then applied construction adhesive to each additional layer as he built up each component, one lamination at a time (B, C, D).

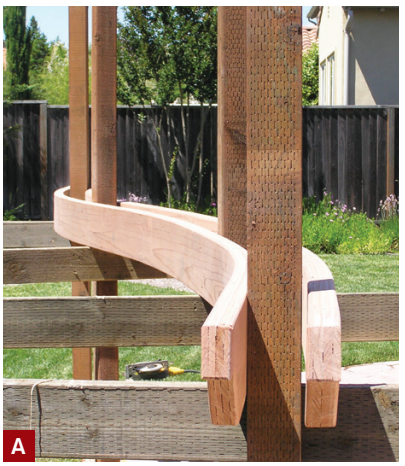
use to resaw stock, but I've found that it's faster to just make two passes on a table saw. If you're fortunate, you'll have access to a lumberyard that can resaw material for you. Before I moved a few years ago, I worked with a great lumberyard that ripped 2x12 material into ¼-inch-thick slices at a reasonable cost.

Next, clamp one end of a sample laminating board to the form, then see how easily the material bends to the form. You do want some resistance, but not to the point that the piece cracks or breaks. As you bend, examine the outer surface of the material and look for any surface splintering; flat-grain material tends to splinter more than vertical-grain material. If there is splintering, you will need to try again with thinner material. I've used material as thick as ¾ inch for the laminating strips for some glue-ups; in other cases, the material needed to be as thin as ⅛ inch.

Once you have determined your requirements and milled the rest of the material to the proper dimensions, the real fun begins. There's no need to be too fussy about how cleanly milled the laminations are—the outside pieces need to have a smooth face, but interior laminations only need to be a consistent thickness. Also, make sure the pieces are as dust free as possible, by brushing them off well.

Depending upon the radius, you may need more clamps than you think, or have readily available. Over the years, I've acquired many different types of clamps, and I choose a specific type depending on what I'm doing. For example, one-handed quick clamps are great for starting and getting the material into rough position, but they don't usually create enough pressure. If I can, I use spring clamps, but often I need to use bar clamps. If the material is wide, I may use K-style or cabinet clamps for their wider surface area. Or I will use spring or bar clamps on each side of the material.

For adhesives, I've tried many types, some with more success than others.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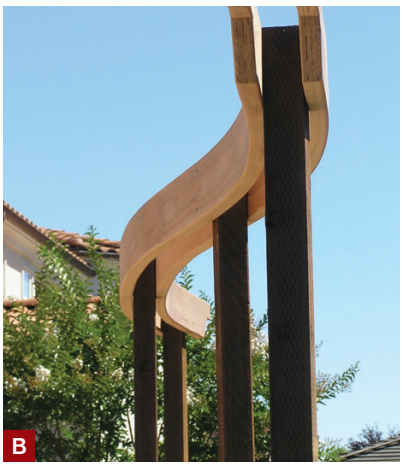
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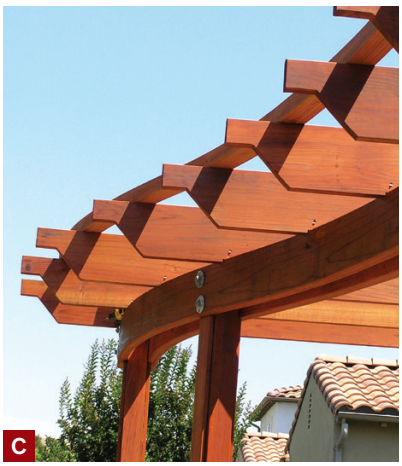
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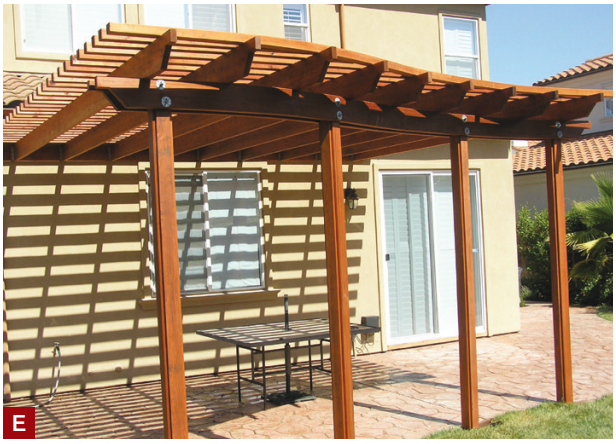
E

Once the author had cleaned up the edges of the beams with a power planer and random orbit sander and rounded over the corners with a router (A), he lifted the beams into position and bolted them to the support posts (B). After installing the rafters, he capped the pergola with the curved laminated stringer, which he glued up simultaneously along with the support beams (C). Then he installed the remaining straight redwood stringers to complete the project (D, E).

Carpenter's glue is fine for smaller pieces, though it has a limited working time, which makes it unsuitable for larger surface areas. You have to be able to mate the surfaces before the glue starts to skim over, since failure to do so will result in a weak bond.

I've tried polyurethane glues (such as Gorilla Glue) with mixed success. Some pieces seemed fine but others failed, so I don't recommend them. Instead, my go-to adhesive for most laminations is two-part epoxy. It is expensive, but it has the qualities I'm looking for: long work life, strength, and a waterproof bond. It reaches almost full strength fairly quickly, allowing more laminations in a given period. If you are comfortable with what you are doing and reasonably quick, you can apply it to multiple layers and clamp them all at once. Just make sure you have it clamped up before the epoxy starts to set up. The amount of hardener you use and the specifics of the epoxy should allow you to determine how much working time you will have.

By the way, not all epoxies are the same. Make sure you use an adhesive epoxy, like West System. I've found that this company is a good source for various types of epoxy resins and hardeners, as well as for technical information and support.

Once the adhesive has set, you can release the clamps, and you should have a permanent shape that matches your form. All that is left to do is plane and sand the edges of the lamination smooth, and install. I start by using a small power planer if the laminations are offset more than 1/16 inch or so. Then I follow up with a oscillating sander, beginning with courser grits and moving to 100 to 120 grit for outside parts. I also radius the corner edges with a palm router. ❖

Mark Ellis owns Creative Redwood Designs in Pioneer, Calif. Follow him on Facebook at CreativeRedwoodDesigns.