

## Free-form steam-bending

USE A STANDARD STRAP TO PRE-BEND THE WOOD, THEN WRAP IT AROUND ANY FORM

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### A LOOK INSIDE STEAM-BENT WOOD

Wood fibers are held together by a natural adhesive called lignin. The lignin bond can be loosened temporarily by heating the wood to between 190°F and 230°F, usually with steam. The heated wood can then be bent and will retain its new shape when cool.

The key concept here is that wood will only stretch about 2% of its length before the fibers begin to fail. But it will compress to a phenomenal degree before it fails—I routinely bend 1½-in.-thick hardwoods to as little as a 1-in. radius.

The traditional solution is to use a compression strap. This has two drawbacks: First, complicated shapes are impractical for a metal strap. Second, there is no compression on the outside face next to the strap, so there is more chance of the shape springing back. However, if the wood is rolled 180° and immediately bent again, then the lignin bond is loosened throughout the blank. The wood can now be bent and twisted at will without a strap and with almost no springback.

If you can create a shape with a strip of paper without tearing or folding it, in theory you can bend wood to that same shape. However, because wood compresses much better than it stretches, conventional steam-bending requires the use of a compression strap (see below), and it can be difficult to create a compression strap for unusual shapes.

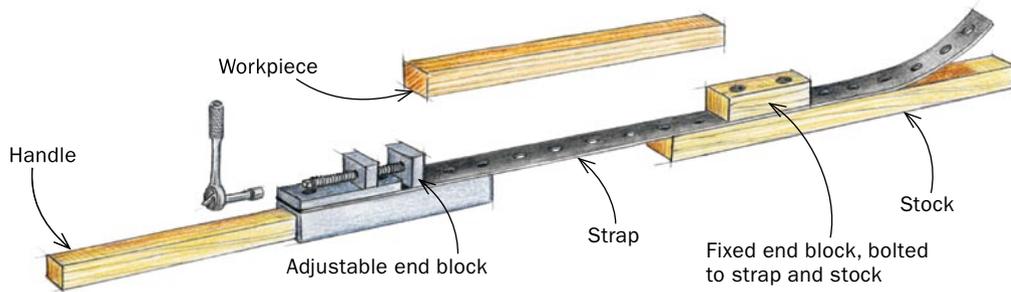
The method I'll describe uses a compression strap to pre-bend the wood, but does away with it when bending the desired shape, allowing you to bend wood through two planes at once and even twist it, adding a new dimension to your woodworking. For example, the table leg at left sweeps outward at the bottom along a 45° axis.

### Bend the wood twice to make it pliable

The first step is to make a traditional bending form with a radius tighter than the desired final shape. This will allow the wood fibers to be compressed and the lignin bonds loosened in the areas that you will later bend free-form.

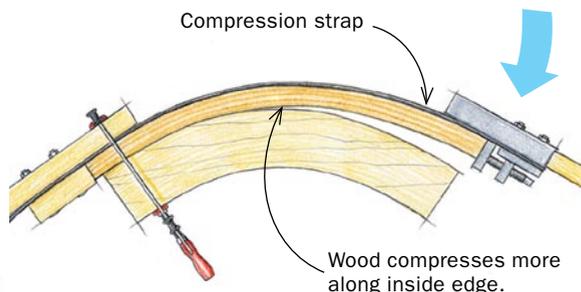
The blanks to be bent should be approximately 1/8 in. larger in thickness and width and about 4 in. longer than the final length. In this way, any torn

### THE AUTHOR'S METHOD STARTS WITH A COMPRESSION STRAP



### PRE-BEND WITH A COMPRESSION STRAP

After steaming, place the blank in a compression strap and bend it around a form. Then quickly remove the wood, roll it 180°, and bend it in the opposite direction.

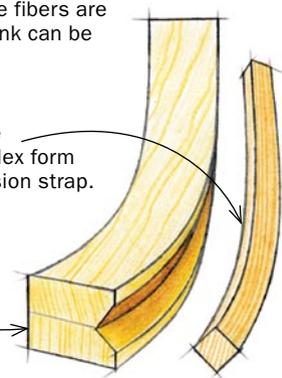


### THEN BEND TO DESIRED SHAPE

Now that all of the fibers are loosened, the blank can be easily shaped.

Workpiece can be clamped to complex form without compression strap.

Bending form



## 1 Steam the wood



**In the box.** Let the blank steam for an hour per inch of thickness. Use gloves when removing the hot wood.

wood fibers can be removed when the wood is shaped to the desired dimensions.

Steam the blank for an hour per inch of thickness, then take it from the steambox, secure it in the strap assembly, and bend it around the form. Almost immediately, straighten out the blank (holding one end in a vise if needed), roll it over face-for-face in the strap assembly, and bend it around the form again. Remove the blank from the strap and straighten it again. Now that the entire bent section has had the lignin loosened, the blank can be bent free-form without a compression strap.

Although the wood cools fairly slowly, complete all the steps as quickly as possible and get the blank clamped onto its final form. If it takes more than five or 10 minutes, the blank can be reheated in the steambox. This should take only five or 10 more minutes because the inside of the blank has remained hot.

### **Bend the softened wood into free-form designs**

When you bend the wood a third time, without the compression strap, you'll be able to create shapes beyond the scope of traditional steam-bending.

**Bend a leg that is strong and elegant**—A leg that sweeps out near the bottom along a 45° axis usually must be cut from a large blank. This invariably leaves short grain, making the foot weak and unattractive. Steam-bending would make more sense as it consumes less wood and allows the grain to follow the shape of the leg, maintaining its strength and improving the look.

However, using a compression strap is impractical because there is only a corner of the blank for the strap to bear on. By double-bending the leg as described, you can then bend it along the edge without a compression strap. The first step is to build a V-shaped form made from two sections shaped with a

## 2 Double-bend the wood to loosen the fibers



**Bend, straighten, and bend again.** Place the blank in the compression strap, tighten the end clamp, and then bend it around the form (left). Remove the blank from the strap, place it loosely in a vise, and lever it until it is almost straight (center). Flip the blank so that the face that was against the strap is now against the form, and bend it again. In this way the lignin that bonds the wood fibers is loosened across the width of the blank (right).



## 3 Bend the wood around a form...



**Create an angled form.** To make the bending form that holds the blank on its edge, use a 45° chamfer bit in a router table to shape the two halves of the form (above). There is no need to use a compression strap on the double-bent blank, but you do need “V”-shaped clamp blocks (right).



### Wood that steam-bends well

When wood is kiln dried, the lignin is set permanently in place, so try to steam-bend only air-dried wood with a moisture content of around 15%. This is usually available from smaller sawmills and lumberyards. Among the best woods for steam-bending are ash, red and white oak, walnut, hickory, and elm. Slightly more difficult are cherry, maple, and birch. Woods that do not steam-bend include softer hardwoods like basswood and poplar, curly domestic hardwoods, all softwoods, and most exotic woods including mahogany and teak.

## ...or give it a twist



**Twist the wood and preserve the new shape.** With one end of the blank clamped in a vise, twist the wood 180° using a long board as a handle. To let the wood dry in its new shape without springing back, clamp the turning handle to a fixed object.

large chamfer bit. You'll also need to cut some clamping blocks with V notches. Clamp the double-bent blank into the form and leave it to dry. The drying time depends on the size of the blank and the temperature and humidity in the workshop. A 1½-in.-sq. piece of ash will take about a week to dry down to 7% to 8% humidity if there is a modest airflow across the wood.

**A new twist on steam-bending**—With conventional steam-bending, getting wood to twist is difficult and the results often are disappointing. You'd be lucky to achieve 90° of twist before the fibers separate, and then the shape will untwist even after the wood is dry because the lignin bond was not completely broken. Wood that has been double-bent can be twisted to around 180° before the wood fibers fail.

Square or rectangular cross sections work best for twisting. Before you start, cut a hole that matches the end of the blank in the middle of a piece of wood 3 ft. to 4 ft. long and at least 3 in. wider than the blank. This will serve as a handle. Double-bend the blank around a form with about a 20-in. radius. Reheat it and then clamp one end of the hot blank in a heavy-duty vise and insert the other into the handle, applying a clamp on either side.

Twist the blank slowly. There will be some springback, so I recommend overtwisting by about 10° to 15°. When you've achieved the desired twist, clamp the handle to a stationary object and allow the blank to dry.

Variations on the twist include tapering the wood before it is twisted to cause the twist to “speed up” as the wood narrows. You also can rabbet the corners and inset a contrasting wood (use epoxy to withstand the temperature and moisture). □

 [FineWoodworking.com](http://FineWoodworking.com)

Michael Fortune demonstrates the double-bending process in a video.