

My experience in steam bending

Gail P. Cone

Project



- A rocking chair for my wife.
- Challenge my skills in woodworking.

To bend or not to bend that is the question.

- Options:
 - Cut radius from single stock (\$\$\$\$\$)
 - Glue Up and cut radius (change in grain may be unwanted)
 - Glue-Laminate thin stock over form.
 - Take the Steam Bending challenge.
- I chose steam bending for 3 reasons.
 - Consistent grain desired
 - A solid block would have been 28x6x3.5 inches.
 - And simply, I wanted the challenge.

Steam bending how does it work?

- Heat softens a polymer called lignin that primarily makes up the secondary cell walls in wood and other plants.
- In this softened state wood cell fibers can stretch and move about when forced over a bending form.
- When cooled lignin returns to a solid and causes the wood cell fibers to be locked in place.

Tools

- Patience, Patience, Patience
- Large barrel or drum, depends on project and wood
- Bending form (fabricate to project requirements)
- Steam Chamber (fabricate/purchase)
- Steam generator (tea kettle w/neck extension)
- Reliable heat source (Propane stove)
- Clamps (may need to fabricate)
- Gloves (arm protection recommended)
- Note, Rockler Woodworking now has a steam bending kit and plan. Don't know how good it is.

Project Considerations

- Research steam bending.
 - Article in WOOD Mar. 2007 (#175) pg 52-57.
- Desired species for your project (see suggested list)
- Radius and shape desired
- Shape: simple curve, compound, twist
- Dimensions (plan for some recoil, depending on species & wood thickness).
- Plan to experiment to test your setup.
- Chose clear straight grain wood. Air dried if possible.

Some woods that bend

- Ash
- Beech
- Birch
- Cherry (My choice)
- Elm
- Red or White oak
- Walnut
- Hard or Soft Maple

The pieces

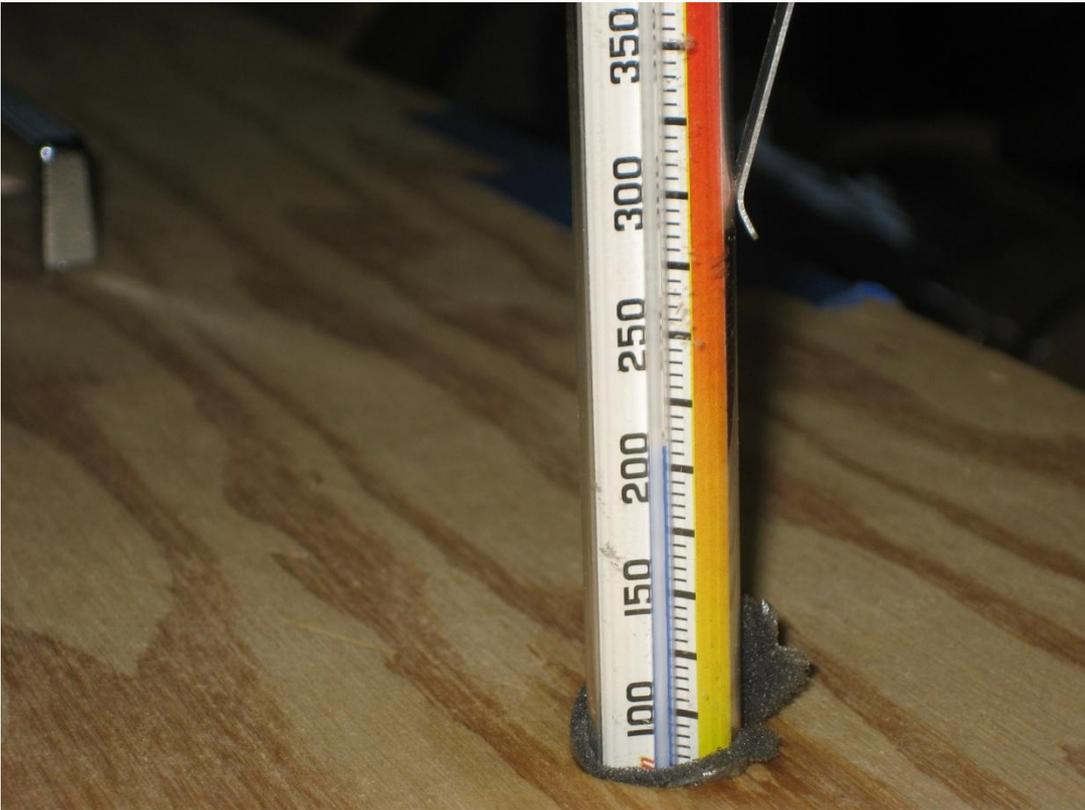


My steam chamber



- $\frac{3}{4}$ ply, Marine suggested.
- Screws, Glue
- Large dowel (PVC suggested). I used wood.
- Canning Thermometer.
- Hinges and clasp.
- Sealing material.
- Pipe for vent hole.
- Plastic to cover chamber.
- My chamber measured 44x10x10.
- Handle for easy movement.

How hot is it in there?



- Used candy thermometer to track chamber heating progress.
- Hit near 220 deg. in the real thing.

Inside look



- When heated the dowels sagged big time.
- Should have used PVC pipe as suggested in WOOD article.
- Expect lots of condensation.

Steamer



- First attempt at creating steam used a hot plate as the heat source. Would have been hard pressed to make tea!
- Switched heat source to propane stove. This worked quite well.
- Note the spout extension. This was a sink drain pipe I had around.

Real setup



- Propane stove works quite well for this relatively small steamer.
- Had to use plastic to help hold heat in.

First bending form



- Used 2x6 douglas fir as primary construction material.
- Lots of glue
- Challenge was to obtain a uniform surface and correct radius.
- 30x5x6

Soaking it



- Kiln dried lumber must be soaked!
- You can't soak it too long. 2 weeks for my piece.
- Weight it down so it is fully submerged.
- Don't forget the fabric softener. The freshly laundered odor will go away. Will not affect finishing.
- Stir it up every few hours and add water as needed to keep the project covered.

Notes

- Use sound construction if making your own chamber. The heat and steam WILL take it's toll.
- During steaming your project wood may tend to deform (wood stress, irregularities in chamber). Don't be alarmed as your form should correct this.
- Your project wood will expand some so your form should be constructed to allow for this.
- Always plan a little extra length on your bending material. You will be glad you did when it comes time to clamp the material in your bending form.
- Plan for some springback. Some guess work here.

Look ahead

- Take precautions to keep from being burned. Gloves and long sleeved shirt are recommend.
- Steaming can be messy, plan appropriate location.
- Limit access to area when steaming.
- Have all tools and supplies at hand before progressing with each step.
 - clamps, wrenches, gloves, water, extra propane, etc.
- Have an extra pair of hands available during the bending and clamping step.

Process

- Soak wood.
 - Time? My final piece was in for 2 weeks.
 - Used fabric softener to aid in water absorption.
- Preheat chamber.
- Move piece to steam chamber and seal.
- May have to wrap chamber in plastic to build and hold temperature.
- Maintain water and propane as required.
- Time in chamber depends on material being steamed. Plan for 2-3 hours and monitor chamber temperature.
- Turn off heat source and remove material from chamber. Don't forget the gloves and long sleeved shirt.
- Move quickly to bending form! Lignin starts to cool fast.
- Clamp material on form. Work from fixed end. With my homemade clamps I used a pneumatic wrench to pull down the clamps.
- Don't be in a hurry to remove material. Depends again on size, species, etc. I waited about a week.

My first test.



- First tested on small piece.
- Form worked well for this small piece.
- Had to remake bending form for the real thing.
- Clamp anchors were not strong enough for larger pieces.
- Radius had to be refined.
- Very little recoil/spring back.

Second test.



- Then there was a loud crack!
- This is where the patience thing comes in.
 - Much more soaking
 - Much more heat
 - New form!
- **I lied** --- this was supposed to be the real thing.

The real thing!



- Note the new bending form
 - Adjusted radius
 - Better clamping
- Note the stain. Using same species for clamp protectors may help prevent.
- Note, the way the clamps are held on the bottom edge of the form.
- Surface area has thin layer of ply to hide form imperfections.
- Ply also absorbed moisture.

Raw end result



- Eureka, I have a back support that I can now try to mess up.
- Compound drilling was next!!

Interesting Lignin facts

- Provides secondary wood cell wall structure.
- Helps cells channel water.
- One of the most abundant organic polymers on earth.
- Makes up 25-30% of woods mass.
- Causes paper to turn yellow (removed in high quality paper)
- Refined lignin has many uses (1.1mil. Tons yr):
 - Used as fuel
 - Used in lieu of plastic in some molded items (can be burned).
 - Expandable foam
 - In large part, adds taste in smoked foods.