

Some Design Considerations for Multi-Axis Work

By Johnna Y. Klukas, text and images copyright 2018, all rights reserved.

DISCLAIMER

Woodworking is an inherently dangerous activity. Any non-woodworking techniques described here probably aren't all that safe, either. Sharp tools, powerful motors, big lumps of wood, chemicals, fumes, etc. can cause you serious bodily injury or even death. This document is NOT intended as a substitute for instruction by a qualified teacher, just a description of the process I follow when planning and executing a multi-axis woodturning project. I take no responsibility for any mishaps you may experience during a fit of inspiration. You've been warned.

AUTHOR'S NOTE: Multi-axis woodturning can involve turning as much air as wood. The blank being turned may be significantly out of balance, meaning that a slow spindle speed is necessary to keep the lathe from walking around the workshop. It's not for the faint of heart, but it's also something that can be built up to gradually. It doesn't take a huge amount of offset to make a dramatic change in the way two surfaces interact. Use sound wood and small offsets to start, follow normal woodturning safety procedures and use good tool technique. If you don't know what those are, seek out a qualified teacher and take some lessons first.

Introduction

This document outlines the process I follow, more or less, when considering a new multi-axis turning project, or, really, any woodturning project I have in mind. It is not the only way to approach a project, but it has worked well for me for a good many years now. As they say in auto commercials, "Your mileage may vary."

Design

My goal in any woodworking project is to balance the overall visual impression with underlying form and function. I am particularly interested in the contrasts between the surfaces I'm creating. For instance, hard edges delineate two surfaces more obviously than soft edges and will reflect light or cast shadow differently from soft or rounded edges. Rounded edges create a gradient from light to dark. Even the simplest design depends on these principles. A gentle curve or a small angle between two adjacent surfaces can make a dramatic statement in the right lighting conditions.

Figured wood vs. plain wood, grain and species also factor into my thinking. Unusual features in the wood, such as spalting, prominent grain, heartwood/sapwood, etc., can become focal points, as can added color, inlays, texture, etc. Choosing one element as the dominant design characteristic tends to be more effective than trying to do all things in one piece. But, that's a rule of thumb, and rules are made to be broken.

For my multi-axis work, I tend to focus on the form itself, the way the edges and surfaces interact. I tend to use applied color and applied textures sparingly. If a blank has a unique feature, I do like to incorporate that into the design (see picture, below). And if in the process of turning I uncover something interesting in the blank, it's likely I'll consider altering my design to accommodate it if possible.



Picture 1: "Landscape" (2018, work in progress, by Johnna Y. Klukas) Cherry, approx. 10" L x 5.5" W x 1.5" D. Still mounted on its turning jig and awaiting off-lathe finishing work. The large crack, which I reinforced by gluing braces across each end of the board, was why I chose to use this piece of cherry to begin with. On the other hand, I would never have used this board if I couldn't secure the crack sufficiently.

So, in a nutshell, there are two phases in my design process:

Phase one is the design phase, also known as, "what is it?":

- Functional vs. not
 - If a piece is meant to be functional, the form I choose shouldn't interfere with that.
- Abstract vs. representational
 - Corollary: Every feature that appears in the final result should look like it was put there intentionally. Even if it wasn't.
- Planned vs. spontaneous design
 - Do I have a reference sketch or am I winging it? Either approach is valid, and I may switch approaches mid-stream, but it's useful to know which way I'm starting out.
- Wall-mounted vs. free-standing vs. on a base vs. ???
 - How will the light hit the surfaces of the finished piece when it's being displayed? For a functional item, it may be on a shelf or in a cabinet between uses, or on the dinner

table. For a sculpture, it could be on a desk or a wall. I can't control the environment a piece ends up in, but I can think about how it would look in "typical" lighting situations.

Phase two is the "can I do this?" phase, the bridge between the plan and its execution on the lathe:

- How will the piece be held for each turning axis? (See the "Holding Work for Multi-Axis Turning" section, below)
- Will the dimensions I want to use fit on my lathe?
- Will the cuts I want to make suit my existing tools and skills?
- What sequence do I need to make the cuts in to get the result I want?
- If I'm going to sand the surfaces smooth, how will I do that?
 - On the lathe, with the lathe running
 - On the lathe with the power off
 - Off the lathe
- If the piece will be colored, decorated, textured, etc., when do I apply these things to get the result I want:
 - as each surface is completed, then cut through them to the next surface
 - wait until the turning is finished, then do all the coloring and texturing
- What kind(s) of finish will I use?
 - Oil-based vs water-based
 - My finish should be compatible with any coloring agent I've used on the piece.
 - Spray vs. hand-applied
 - Gloss vs. satin. vs matte
- How will the piece be held for finishing?

These two phases are repeatable, of course. For example, if I can't figure out how to mount something to make what I want to safely, it's "back to the drawing board" of phase one to make the changes, then back to phase two for re-testing. Repeat until I'm satisfied with the process I'm going to use.

Holding work for multi-axis turning

- Turning between centers
 - I prefer using the toothed “Stebcenters” or similar in the head stock and tailstock.
- Turning with a “faceplate”
 - Commercial chucks vs shop-made
 - May still need to use the tailstock for support
- Reference points are **critical** for realigning the piece if you have to return to a given axis
 - Make as many reference points as you can. These can be anything from small indentations with the tail stock to noticing the alignment between a surface and the tool rest or lathe bed, a mark on your chuck and the workpiece, etc.
 - Don’t remove your reference points until it’s absolutely necessary.
- Dealing with off-balance blanks and lathe vibration
 - Even a small offset can cause large lathe vibration
 - Keep speeds low enough to reduce vibration to a minimum
 - For faceplate orientation turnings, a heavy chuck helps to stabilize the off-center blank
 - For faceplate orientation turnings, use a counterweight to re-balance the off-center blank
 - Some commercial chucks have counterweights available (e.g., Escoulen, Penn State)
 - A bolt or screw with washers can work with a shop-made jig. Vary the number of washers and placement of the screw to offset the weight of the blank. Doesn’t require a lot of mass, especially if the chuck itself is heavy.
- Potential reference point “drift”
 - Wood deformation (happens a lot in between-centers)
 - Have multiple references where possible
 - Reinforce the mount points. Thin superglue is good for this if you’re not concerned about staining.
 - The piece shifts on its mount during turning
 - Tighten everything up as much as is reasonable without damaging yourself or the equipment. If it simply won’t hold, consider another work-holding method.
 - **TAKE LIGHT CUTS.**



Picture 2: "Transit" (2018, work in progress, by Johnna Y. Klukas) Poplar, approx. 7" L x 5.5" W x 1.5" D. Maximum offset from center: ¼". Awaiting off-lathe finishing work. Poplar is lightweight, stable and easy to cut. It's one of my favorite woods to use for practicing techniques or for working out ideas. Given that it can also have spectacular color contrasts and figure, as seen in the above image, it can also be a great wood for a finished project.

Execution

- **SAFETY FIRST!**
 - Many people use only eye protection when they turn, I wear and recommend a full faceshield, preferably one with a frame around the shield itself.
 - Follow ALL woodturning safety precautions, including checking your blank for soundness and your turning equipment for excessive wear, etc.
- Prepare the blank for mounting. Note that if there will be several different methods of holding the work during the turning process, you may have to make the mount point for a given axis "when the time arises" as opposed to being able to make all the mount points at once.
- RPMs: faster is better, but

- Want: minimal lathe vibration. “Fast” and “fast enough” are not necessarily the same thing. 250 RPM may be too fast for an out of balance blank. (Cutting edge placement, see below, factors into this.)
- Sharp tools are essential. A sharp edge will cut with less resistance at a slower rotational speed than a dull edge will.
- Let the tool slice at the wood rather than forcing it into the cut.
- **TAKE LIGHT CUTS.**
- The tool rest is also a TOOL
 - Use a sturdy tool rest, and make sure its load-bearing surface is smooth.
 - Make sure the tool rest is securely locked in position.
 - Place it at the right height for the cut you want to make. If you switch tools, ensure the height is correct with each tool.
 - Place it at the right distance for the cut you want to make.
 - Keep your fingers behind the tool rest.
 - **TAKE LIGHT CUTS.**
- Cutting edge placement: I attended noted multi-axis turner Mark Sfirri’s rotation at one of the American Association of Woodturners symposia. His advice was (paraphrased):
 - Watch the “ghost” area of the blank. The ghost tells you where wood and air “mix” in the turning. if necessary, use a contrasting background (paper, cardboard, etc.) to make sure the ghost is visible while turning.
 - Place the bevel where it “should” be in relation to the ghost’s outer edge, rather than relying on having the bevel pressing against the wood. You’re turning more air than wood at times, if you’re putting pressure on the bevel, when you get to the air the tool may move into the air pocket. At the very least you’ll have a bumpier cut than you need to, at worst, you could get a nasty catch.
 - **TAKE LIGHT CUTS.**

Conclusion

The design of a multi-axis woodturning project isn’t all that different from any other woodturning project: Develop an idea and see if it’s feasible with the tools, materials and skills you have. If it is, have at it! If not, figure out what you need to do/get/learn to make it work.

Oh, and, if I haven’t mentioned it before this,

TAKE LIGHT CUTS.