Notes on:

SEGMENTED WOODTURNING

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MATHEMATICAL FORMULAS AND CONCEPTS:

A circle contains 360°
Circumference = Diameter x π(3.14)
Diameter = Circumference ⁄ π(3.14)
Segment length = Circumference⁄Number of segments
Segment Angle = 360⁄(2 x the Number of segments)
Number of required segments = Circumference⁄Segment length
(Number of segments x Segment length)⁄π(3.14) = Diameter

CALCULATING COMPOUND MITERS:

Most angles for compound mitering are more easily found in charts, but for those with an interest…
(Using a calculator with trig functions)
Miter Angle (MA) = inverse tan (1 ÷ {cosS • tan[360 ÷ (2N)]})
Blade Angle (BA) = inverse tan (cosMA • tanS)
MA is the miter angle
S is the slope of the vessel (measured from horizontal to side)
BA is the saw blade angle (the bevel cut)
N is the number of staves

CONSTRUCTION OF PLATONIC SOLIDS:

Shape	**Miter Angle**
Tetrahedron (a form built from four triangles)	54.735°
Hexahedron (a six-sided cube)	45.000°
Octahedron (a form built from eight triangles)	35.264°
Icosahedron (a spherical form built from twenty triangles)	20.905°
Dodecahedron (a spherical form built from twelve pentagons)	31.717°

VESSEL BUILDING BASICS:

1. Before designing the vessel, construct the feature ring and then use its dimensions to determine the vessel's largest diameter.
2. Mill your boards and use board thickness as the ring heights (less 1/16" for flattening waste).
3. Create a blueprint overlaying rectangles representing the rings and segment end views.

4. Do the math to determine the segment lengths (diameter X 3.14 divided by the number of segments).
5. Rip boards and cut segments. Start with the widest (inside to outside) rings first so leftover material can be reduced for less wide segments. Be sure to mix the source of your segments. Use half-ring technique and assemble rings. Prepare two waste blocks that match the diameters of the top and bottom rings. Use faceplates mounted to waste blocks.
6. Temporarily mount the base ring with hot melt glue.
7. Install a floating base in the base ring (if diameter is greater that about 3.5").
8. Remove base ring, protect the floating disc with blue tape, and glue the base ring onto the base waste block.
9. Flatten the base ring.
10. Use centering device and glue ring #2 into place.
11. Glue top ring onto top waste block.
12. Flatten top ring and mount ring adjacent ring.
13. Continue stacking lower and upper rings.
14. Turn exterior of both upper and lower halves. Occasionally hold the halves together in order to examine the profile.
15. Turn the inside to a consistent wall thickness (about .25" to .3").
16. Glue halves together. Use masking tape barrier to avoid glue squeeze-out contamination on inside during the joining of two halves.
17. Turn off the upper waste block and clean up the last glue joint (inside and outside).
18. Allow the vessel to "cure" for a week before final sanding and applying finish of your choice.
19. Part the vessel from the base waste block, reverse mount, clean up the under side, sign, and finish.

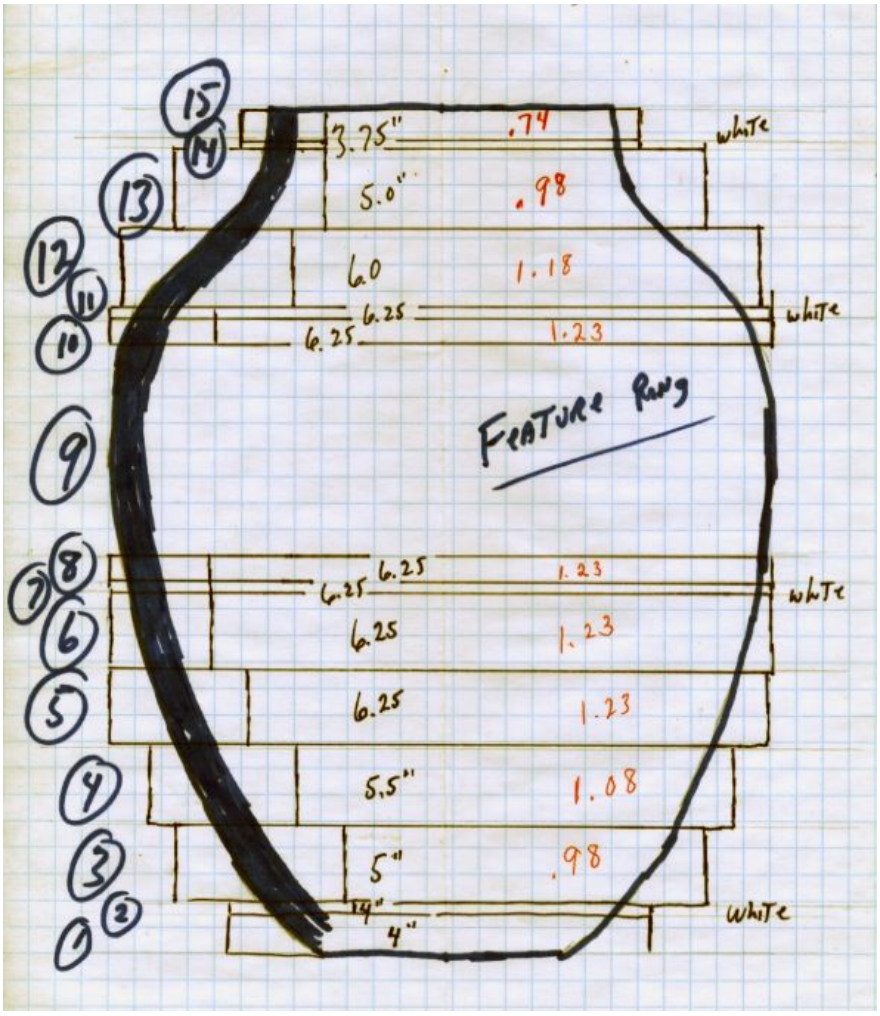
Remember...

- Use only dry wood (under 10% moisture content).
- Avoid cross-grain intersections longer than 1" of opposing wood grain orientation (shorter if possible).
- Always consider the shape as the most important design element (more important than wood type, color combinations, etc). - Never glue two surfaces together that do not fit perfectly and remember - Do not resort to "filling" a joint imperfection; re-do or replace as necessary. The defect will usually show and you will inevitably regret the lack of perfection later.
- Avoid an abundance of "oily wood to oily wood" glue joints.
- Keep, and inform others to keep your turnings from excessive exposure to direct sunlight.

A SAMPLE CUTTING LIST:

Ring Number	Ring Diameter*	Miter Angle	Number of Segments	Width of Segments*	Height of Segments*	Length of Wood Segments* Type	Board Length**
1	5.66	18 o	10	1.50	0.40	1.78 ebony	18
2	6.33	18 o	10	1.50	0.13	1.99 holly	20
3	8.83	9o	20	2.50	0.80	1.39 bubinga	28
4	11.00	9o	20	2.13	0.80	1.73 bubinga	35
5	12.50	9o	20	1.69	0.80	1.96 bubinga	39
6	12.75	9o	20	1.00	0.13	2.00 holly	40
7	12.75	9o	20	1.00	0.19	2.00 ebony	40
FEATURE	12.88	18 o	10	0.88	1.63	n/a n/a	n/a
9	12.63	9o	20	1.29	0.19	1.98 ebony	40
10	12.31	9o	20	1.29	0.13	1.93 holly	39
11	12.00	9o	20	3.44	0.80	1.89 bubinga	38
12	8.00	9o	20	2.63	0.80	1.26 bubinga	25
13	4.11	18 o	10	1.00	0.13	1.29 holly	13
14	3.78	18 o	10	0.90	0.40	1.19 ebony	12
* All figures represent inches							
**Rough estimate based on the length of segments times the number of segments							

Sample Blueprint



Checkered Hollow Forms

This technique can be adapted to many sizes and shapes, but the basic procedures remain the same,

1. Select two woods with good contrast (a light color and a dark color). More than two colors will also work if you align the pieces appropriately.
2. Mill an equal number of identically dimensioned strips of each wood. Once again, variations in width will work if they are assembled in the correct order. For your first attempt at this technique, I suggest keeping things simple with just two different woods, milled all the same thickness (very important).
3. Glue together strips into a “cutting board” style lamination. In general, the lamination should be about 3 or 4 times longer than its width.
4. Clean up the lamination.
5. This step is optional. Re-saw the lamination(s) lengthwise and clean them up into identical thinner laminations. If you skip this step, your vessel will just have taller individual layers.
6. Using the final width and thickness of your lamination(s), design a vessel shape. The height of your vessel should be a multiple of your lamination thickness. For example, if your lamination(s) is 1⁄2” thick, your vessel

might be 10 layers tall or 5” tall. The width of your lamination will determine the maximum diameter of your design.

7. Use a compass and draw circles on your lamination(s) being very careful to place the point of the compass precisely into the middle seam of your lamination.
8. Using a band saw, cut discs from your lamination(s).
9. Use a compass to transfer diameters from your paper design to the discs.
10. Place double-sided tape on the opposite side of the disc and then using your lathe tailstock’s cone center, position the discs onto a backing plate on your lathe. Be extra careful to position the disc as centered as possible onto the backing plate.
11. Use a thin parting tool to cut individual rings from the disc(s). Place the cut disc onto your design blueprint and confirm that you have the correct outside and inside diameters for each ring. It’s a good idea to label the discs before things become confusing.
12. Using your tailstock’s cone center, glue the base disc onto a waste block. Do the same thing with the top disc onto another waste block.
13. True up these discs and proceed to add more rings. You may want to join two rings together in order to speed up the assembly process. Use a magnifier to inspect the seam intersections. You should only have to focus on the two end grain sides; the other intersections should line up automatically.
14. As you stack laminate the rings into the vessel shape, do a minimum amount of turning. Keep the vessel wall as thick as possible until most of the assembly is completed.
15. Join all rings to form two halves of the vessel. The final seam location is your choice. I usually locate my final seam just above the centerline.
16. Individually turn the outside of each half. Frequently hold the two halves together in order to determine and create the most pleasing profile.
17. Turn the insides creating a consistent wall thickness.
18. Remove the top half from its waste block. A parting tool works.
19. Using your tailstock cone as a centering device, glue the two halves together.
20. Finish turn the outside profile.
21. Apply sanding sealer (or proceed with your favorite finishing process).
22. Scrape sanding sealer off and apply another coat. Repeat as necessary to fill the wood pores.
23. After scraping the last coat of sanding sealer, proceed to sand the vessel.
24. Apply finish coats of your choice.
25. Remove vessel from waste block and finish the underside.

26. Sign your work.
27. Have fun!