

# Twisted Turnings, *an exploration of Multi-Axis Turning*

*by*

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# Multi-Axis Turning

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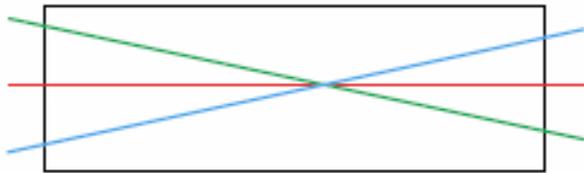


- Turning on one central axis is straightforward and predictable.
  - When a spindle is turned on one central axis, the result (outcome) is always circular or cylindrical
- Changing the axis provides woodturners with unlimited forms, within the limits of the lathe and the wood (Barbara Dill, DEC 2011)
- When many axes are used, forms are randomly created by luck and experimentation
  - Multi-axis turning introduces many more variables that can be used to create a wide array of non-cylindrical shapes
- This class will concentrate on one class of multi-axis turning: ***Three Axis Off-Center Turnings*** that produce a pleasing spiral or 'twisted' shape

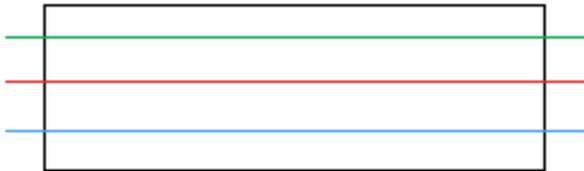
# Examples



# The Basics

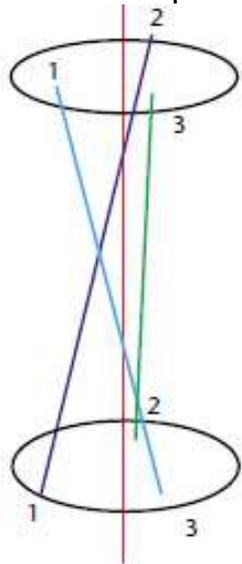


Twisted  
(intersecting) Axis



Parallel  
Axis

There are only two ways a new axis can be placed in relation to the center axis: parallel or intersecting.



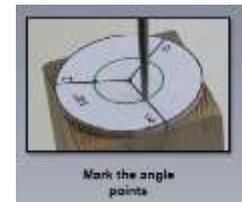
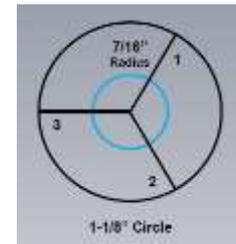
When a new axis intersects the center axis, the outcome looks twisted. Keeping the numbering consistent is essential to help systematically create (or re-create) multi-axis designs

Complex Shape  
from Twisted Axis



# Making the Three Axis Turning

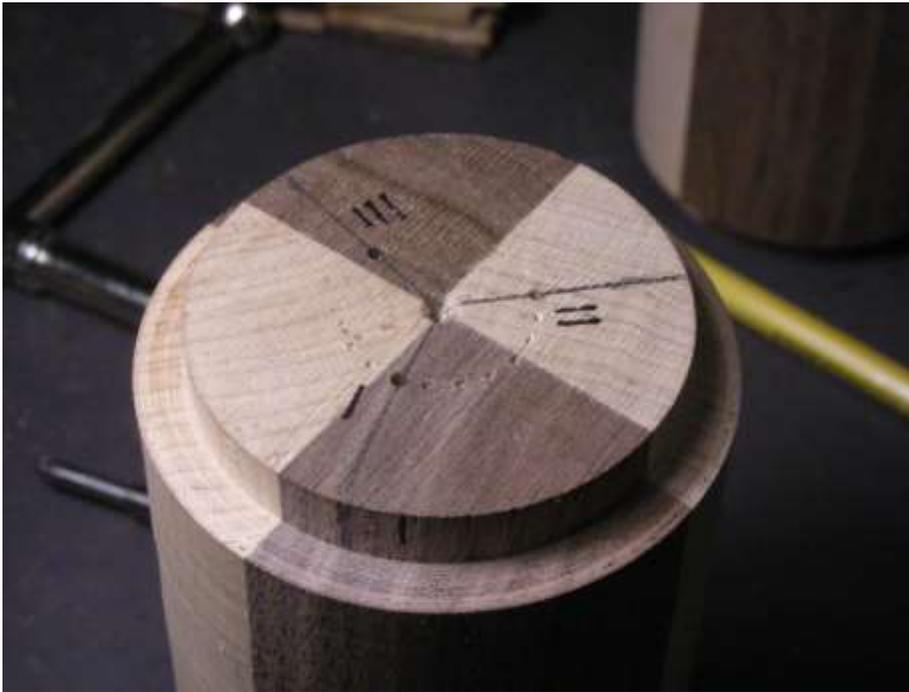
- Turn the spindle round first, with tenons on each end (for later holding)
- For three-axis, mark off 120 degree lines from center
- Determine the off-axis separation ( $\sim 1/3 R$  to  $1/2 R$ ) and mark the off-axis points with a punch
- Number the axis on each end to be turned – be consistent and careful to maintain your numbering scheme
- Use a small sharp four prong drive center (5/8" is good)
- Use higher speeds (stop before vibration) and sharp tools
- Sand arc cuts by hand with the lathe off
- Make sample pieces and careful notes to define shapes



Draw a line to the other end of the blank and repeat the marking and numbering

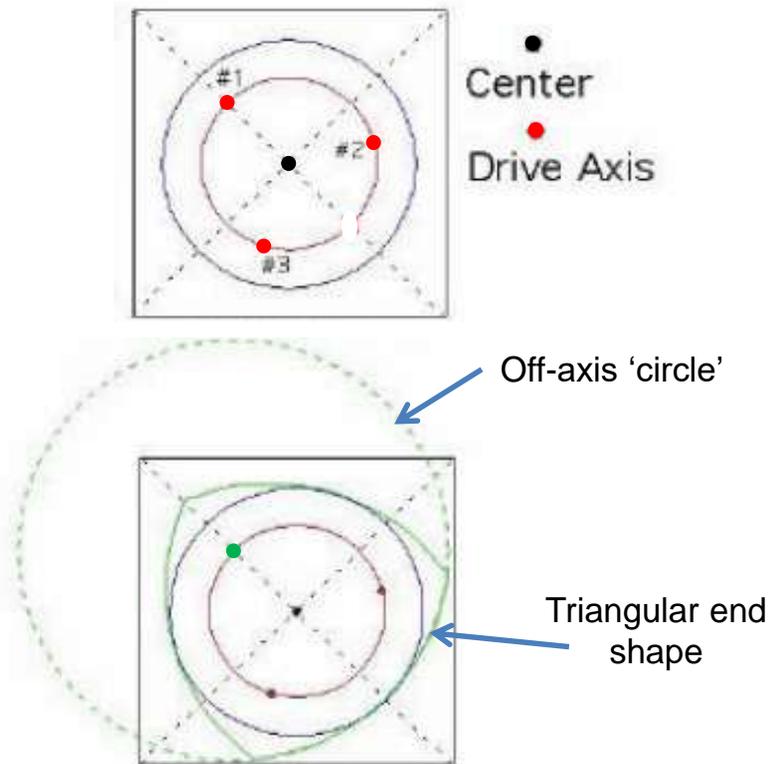
# Marking the Offsets

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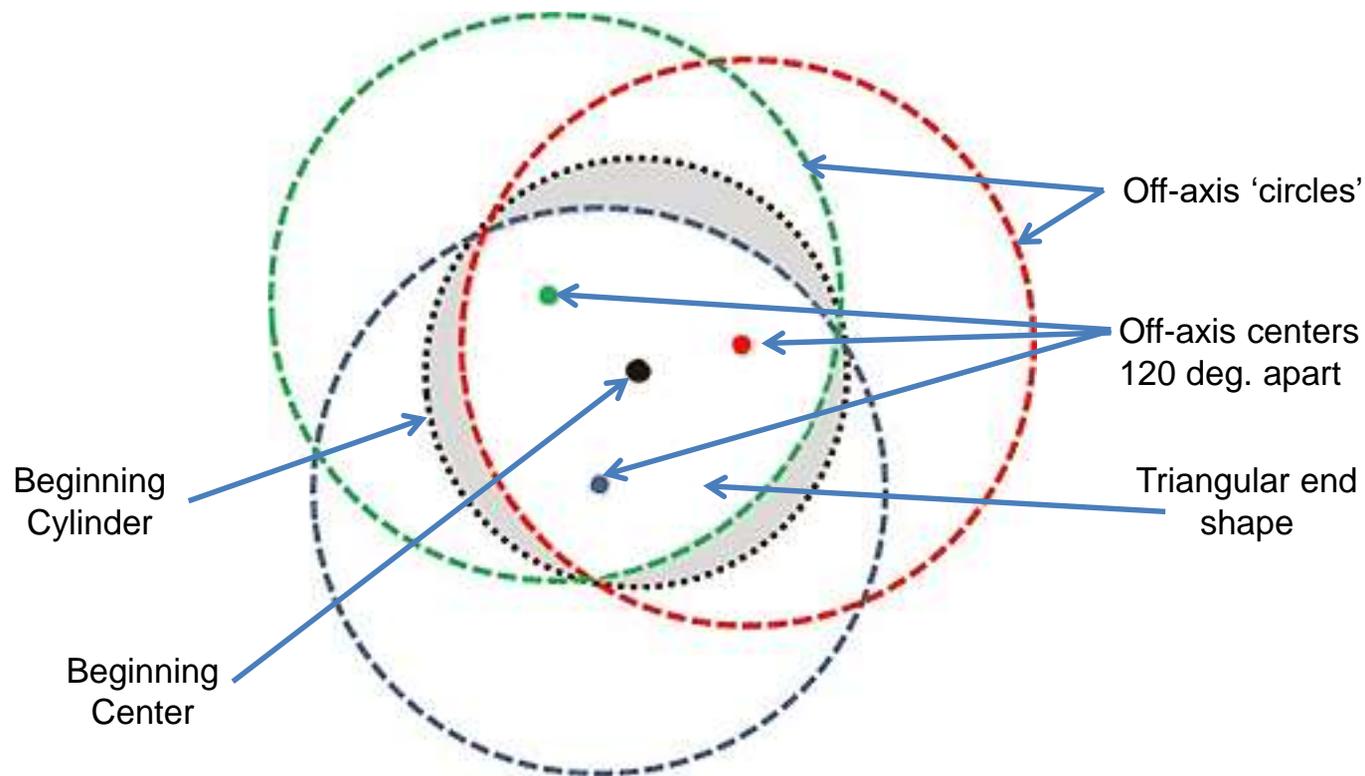
# 3-axis offset yields triangular end shape

- Using a 3-axis offset scheme, with 120 degree separation yields a triangular end shape for the twisted section



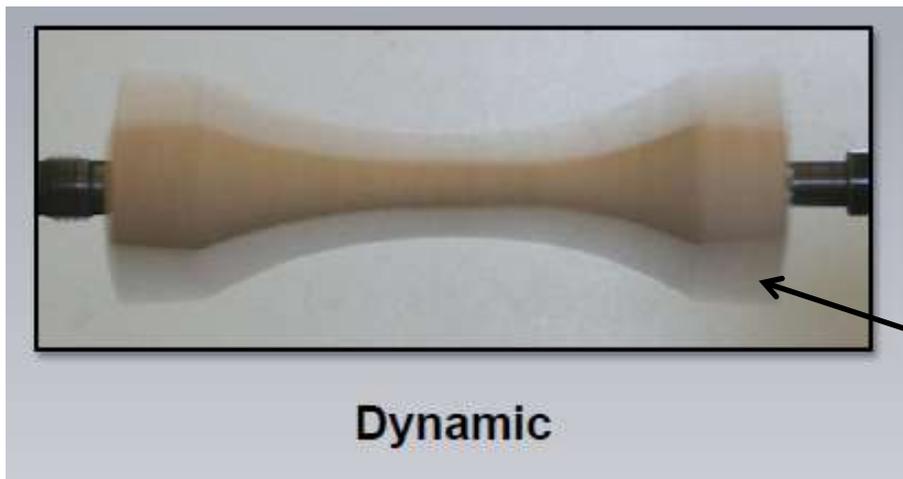
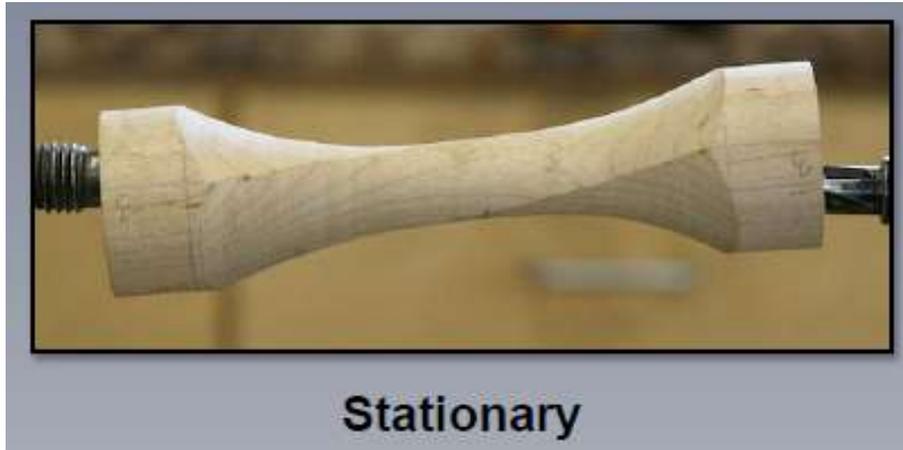
# Making a Triangle from Circles

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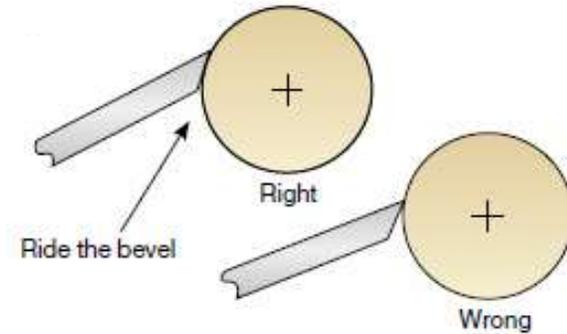


- The three offset intersecting circles yield a triangular end section
- Using a 120 degree offset on centers yields the twist

# A Simple Twisted Turning



'ride the bevel' of your tool when turning



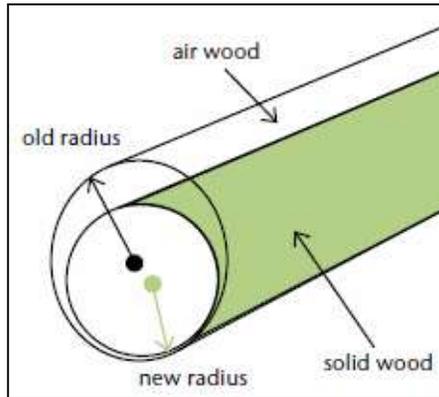
Turning sequence for the end points:

<u>Head</u>	<u>Tail</u>
1	2
2	3
3	1

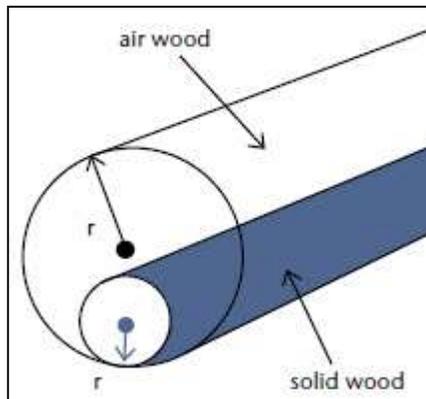
*This is the region where you are 'turning air'*

# Choosing the Offset Points

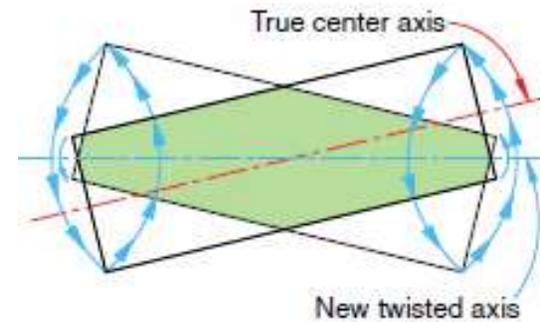
- Selection of the offset affects the final shape and the 'wobble' during turning (as well as the RPM for vibrations)



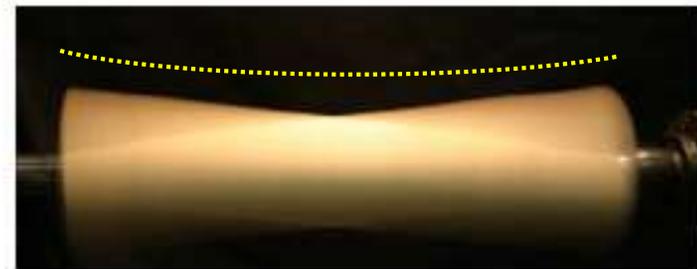
*Small offset*



*Large offset*



*Offset 'wobble'*



*Surface is turned to dotted shadow line*

# Your Assignment

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- Using wood of your choice:
  - Turn the shape into a smooth cylinder
    - (using the roughing gouge)
  - Turn a tenon on each end
    - Approximately  $\frac{3}{4}$  of radius
  - Mark the offsets on each end
    - (approx.  $\frac{1}{2}$  of radius)
  - Mount on offsets and turn the twist
    - Remember the turning sequence
    - Test first with a pencil to confirm direction
    - turn each side twice or until the ends are 'triangular'
  - Finish as desired
    - Mount tenon and hollow out jar

# Exploring Additional Shapes

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- Depicted here are:
  - Sample twisted cylinders, with different twist directions,
  - A twisted goblet and,
  - A tapered, twisted (and carved) vase with a black finish highlighted with liming wax



# More Twisted Shapes

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- Tapered Twisted Shapes can be achieved by starting with a tapered cylinder
- Carving the opening enhances the shape
- Various finishes can enhance the design, such as the black finish shown with liming wax highlights and the natural and black finishes



# Making a Twisted Peppermill

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# Making a Twisted Peppermill



1



2



3



4



5



6

# Making a Twisted Peppermill

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7



8



9



10



11

# Peppermill Examples

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# Cautions and Tips

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1. *The wood lathe is a reasonably safe tool, and it's fun to use ... but it will bite you if you're not careful.*
2. *Anything that can wrap up in the lathe will do so sooner or later.*
3. *Look everything over before you spin it. (turn it by hand first)*
4. *An off-balance piece can jump out of the chuck and pay a call on your nose. (adjust the speed to just below the vibrating range)*
5. *Irregular pieces are more dangerous, and deserve respect.*
6. *Be wary of the vibrations caused by off-axis turnings*
7. *The more your points are off the center axis, the more the object 'wobbles'*
8. *Be very cautious (i.e. approach slowly) when turning the wobbling ends (this is called 'turning air')*
9. *Sanding on a lathe can hurt you; don't take it lightly.*
10. *See that your chisels stay sharp.*
11. *Use the bevel of the tool to contact the wood (slowly)*
12. *Be extra careful when trying new techniques or ideas.*

# Examples

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# Examples

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# Additional Topics

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- Integration of off-center turning techniques with segmented turning designs will be discussed in classroom and evening presentations.
- Because the topic of segmented turning would require a separate class, the techniques will be described in presentation form only
- Sufficient information will be provided for students to explore the techniques on their own
- Representative charts are provided here as an overview of the techniques to be presented

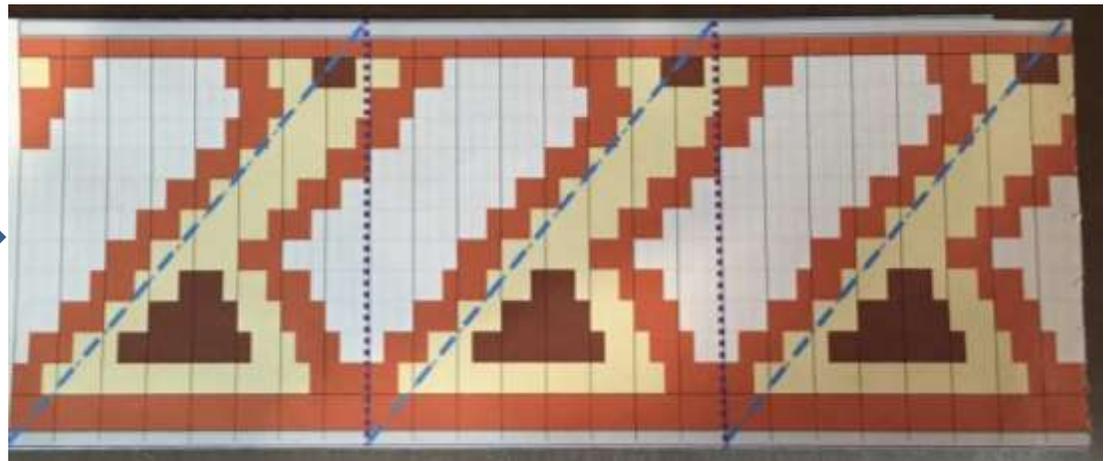
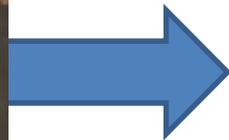
# Translating 3-D to 2-D

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- The twisted shape used repeats every 120 degrees
  - 3 times per circumference
- Laying out a repeating design with the desired number of segments is the basic building block
  - Repeating this design 3 times yields the circumference

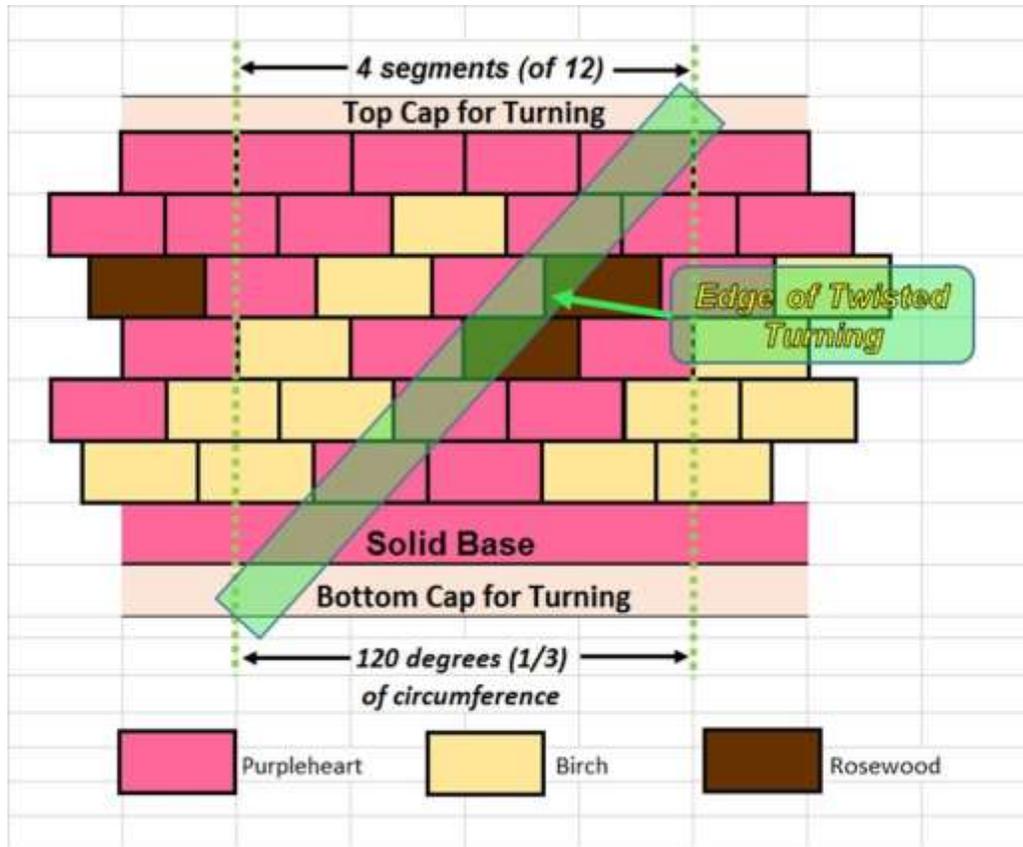


3-D



2-D

# Design versus Actual



# The Finished Bowl



# References

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- Additional off-center turning tutorials, including:
  - *Off-Center Turning, an overview*
  - *Fabricating a Twisted Segmented Vase*
  - *Turning a Twisted Peppermill*
  - *Turning the 'Twisted, Segmented, Slotted Urn'*
- Can be found at my website:
  - <https://sites.google.com/site/cabriturn/>
- For an in-depth discussion of all aspects of off-axis turning, visit Barbara Dill's website at:
  - [www.barbaradill.com](http://www.barbaradill.com)
  - Review the tutorials and the Woodturners Magazine article from 2011