

# Fun with Polygons

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A **STOP** sign is the most common polygon that we see every day. Polygons are all around us yet we rarely stop to think about their designs or shapes. They are all around us in nature and in construction but rarely do we notice them. The comb in a bee hive is made up of a Hexagon (6 sided polygon), the stop sign above is a regular Octagon (8 sided polygon), and the worlds largest office building is a 5 sided polygon the Pentagon.



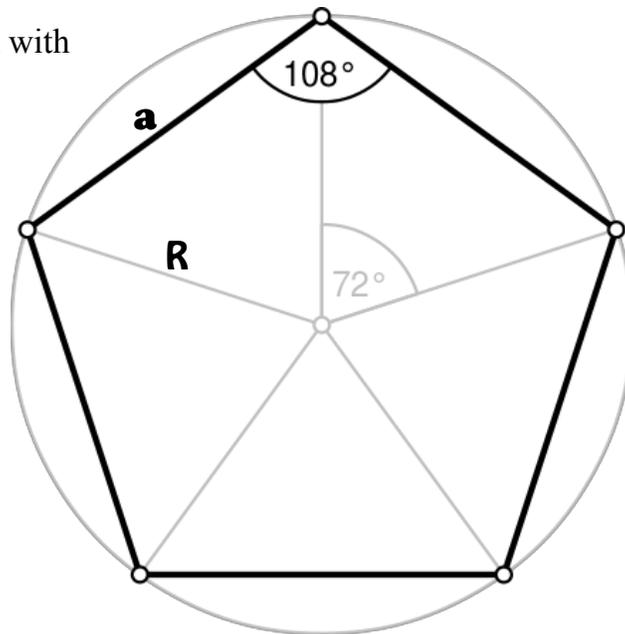
But as common as they are in nature it is uncommon for us to see polygons in woodturning. Those involved in segmented turning worry about the number of sides and the angles of the of the segments when assembling their project but then in most cases they turn them round. In the December issue of the *American Woodturner*, Ted Rasmussen presented an article on “Turning a Five-Sided Box” where he describes the layout for his project. We will take a look at that.

The goal of this demonstration is to determine how to easily layout a regular polygon of any number of sides and any size, and finally turn a multisided polygon into a bowl or an object of your choosing.

First lets define a regular polygon and look at some of the math behind it.

**Regular Polygon (also Equiangular Polygon) Definition:**  
A **polygon** that has all sides equal and all interior angles equal.

A five sided polygon with radius “R” and side length “a”.



To find the length of side “a” use the following formula:

$$a=2R\sin(180/n)$$

a = the length of the side

R = the radius of the circle

n = the number of sides in the polygon

With this formula we can calculate the length of side “a” for any regular polygon with any number of sides “n”. This will allow us to construct a polygon of any size on a selected piece of wood that we can then turn into an art form.

For example with a 5 sided polygon as above lets assume the diameter of the circle is 8 inches. Then R or radius would be 4.0”. If we plug that into the above equation above:

$$\begin{aligned}
 a &= 2 * 4 \sin(180/5) \\
 (180/5) &= 36^\circ \\
 a &= 8 \sin(36) \\
 \sin(36) &= .588 \\
 a &= 8 * .588 \\
 a &= 4.70''
 \end{aligned}$$

So the length of all sides of a 5 sided polygon with a diameter of 8” would be 4.70”. Now all that needs to be done is to lay it out on a turning blank.

For those not comfortable with the math I will try to make it a bit easier with the following table:

No. of Sides	180/N	sin(180/N)
3	60°	0.866
4	45°	0.707
5	36°	0.588
6	30°	0.500
7	25.7°	0.434
8	22.5°	0.383
9	20°	0.342
10	18°	0.309
11	16.4°	0.282
12	15°	0.259

You can see from the chart a hexagon or 6 sided polygon is the only polygon where the radius “R” is equal to side length “a” so with a compass the sides of the polygon can easily be laid out. (R=4 and a=4)

For this demonstration I will layout a 7 sided polygon on a piece of ash and will discuss the various methods of laying out the length of the 7 sides using a compass, protractor, dividers, or digital calipers so that the sides are equal length. A 7 sided blank will then be mounted on the lathe and turned to a bowl. Various mounting methods will be discussed along with some ideas of what can be accomplished with different shapes and designs.

List of potential equipment:

- Screw Chuck
- Face Plate
- Glue Block
- Vacuum Chuck
- Four Jaw Chuck
- 3/8” & 1/2 “ Bowl Gouge
- Parting Tool
- Negative Rake Scraper
- Beading Tool
- Point Tool
- Digital and Vernier Calipers
- Compass
- Dividers
- Scientific Calculator
- Sanding Disk with Various grits
- Safety Glasses and/or Face Shield



Seven sided Polygon

Resources:

- American Woodturner*: December 2015 Vol 30, no 6 - [woodturner.org](http://woodturner.org)
- Wikipedia*: The Free Encyclopedia on the Web - Search Polygons
- Polygons*: A Woodworker’s Guide to Multi-Sided Projects By: Jerry Cole