Tool Geometry
And the Cutting Edge

By Lyndal Anthony

Photography by Joan Overhouse

"Insanity is doing the same thing over and over again but expecting different results.”

Quote first appears in the book “Sudden Death” by Rita Mae Brown

Common Turning Questions…..

Which tool is the best?
What tool angle is the best?
What grind angle is the best?
What grind profile is the best?
Why am I getting so much tear out?

Notice the numerical order

- (3) Which tool is the best? (This should be the third question!)
- (2) What tool angle is the best? (This should be the second question.)
- (4) What grind angle is the best?
  (4) What grind profile is the best? (These should be the last question.)

(1) Why am I getting so much tear out?

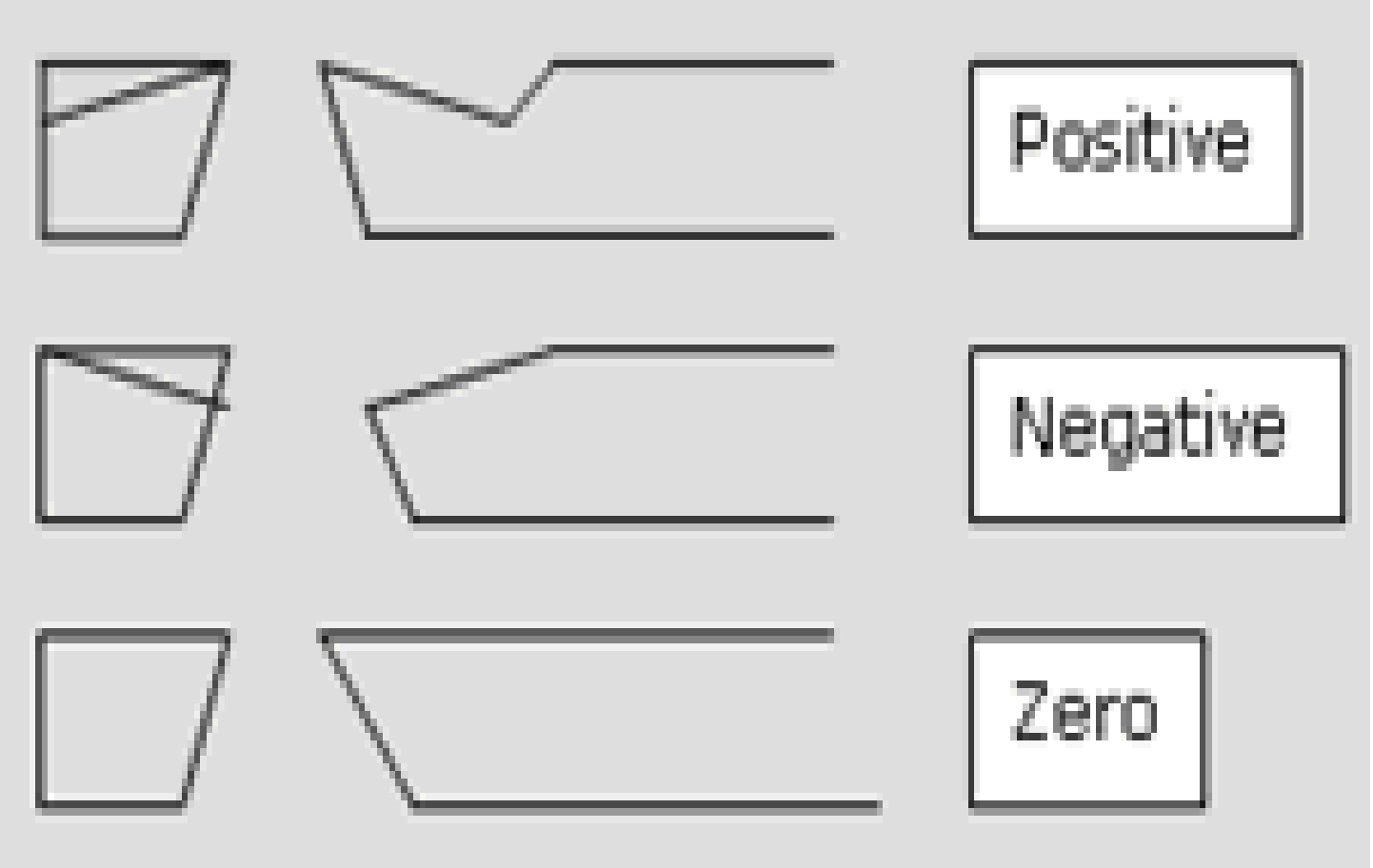
This should be the first question a person asks.

A person should know “How” the tool works and how it cuts wood before he can appreciate what tool to use, what grind angle and etc.

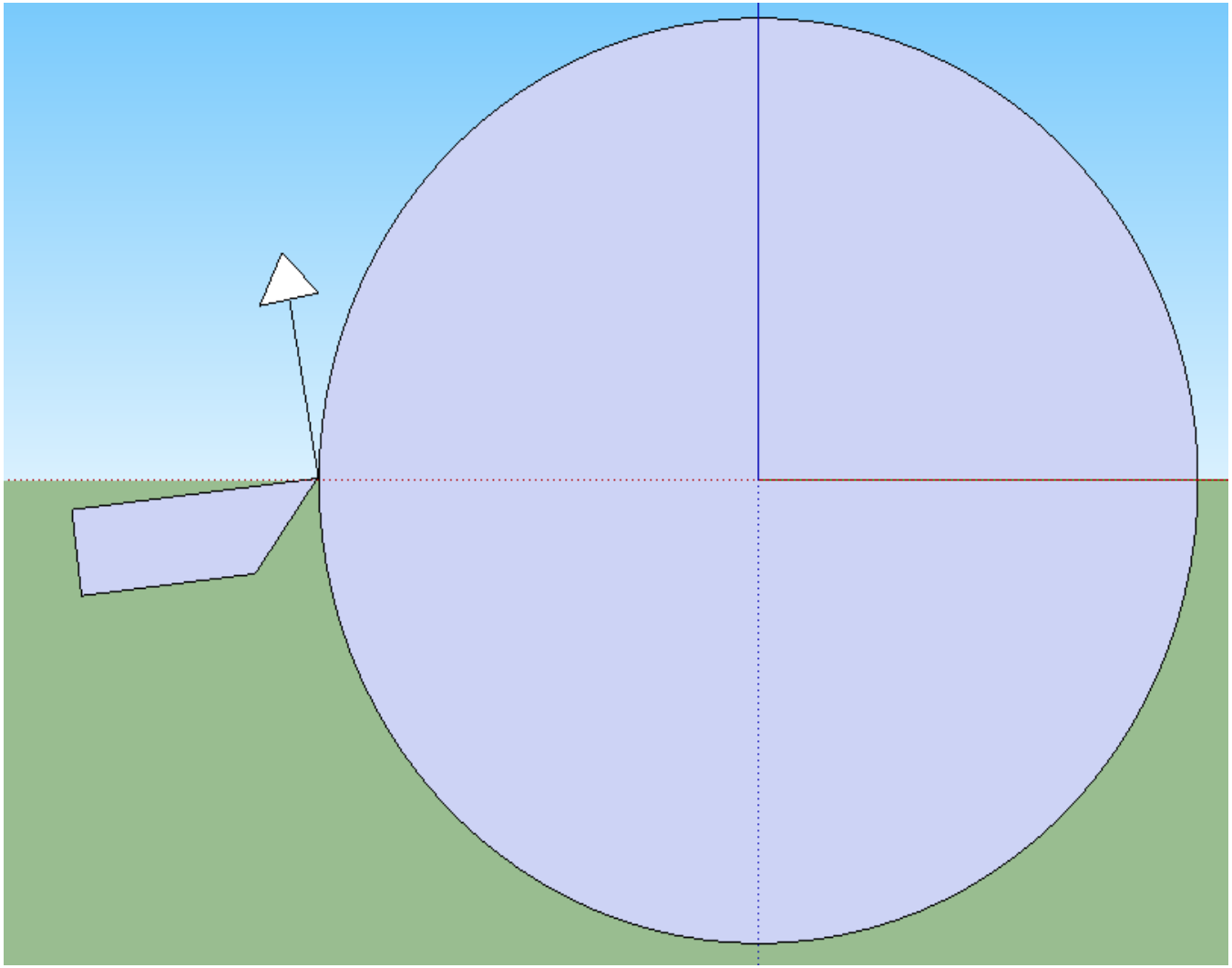
Number one rule:
Rub the bevel!

The bevel not only guides the cut, but it supports the tool during the cut.

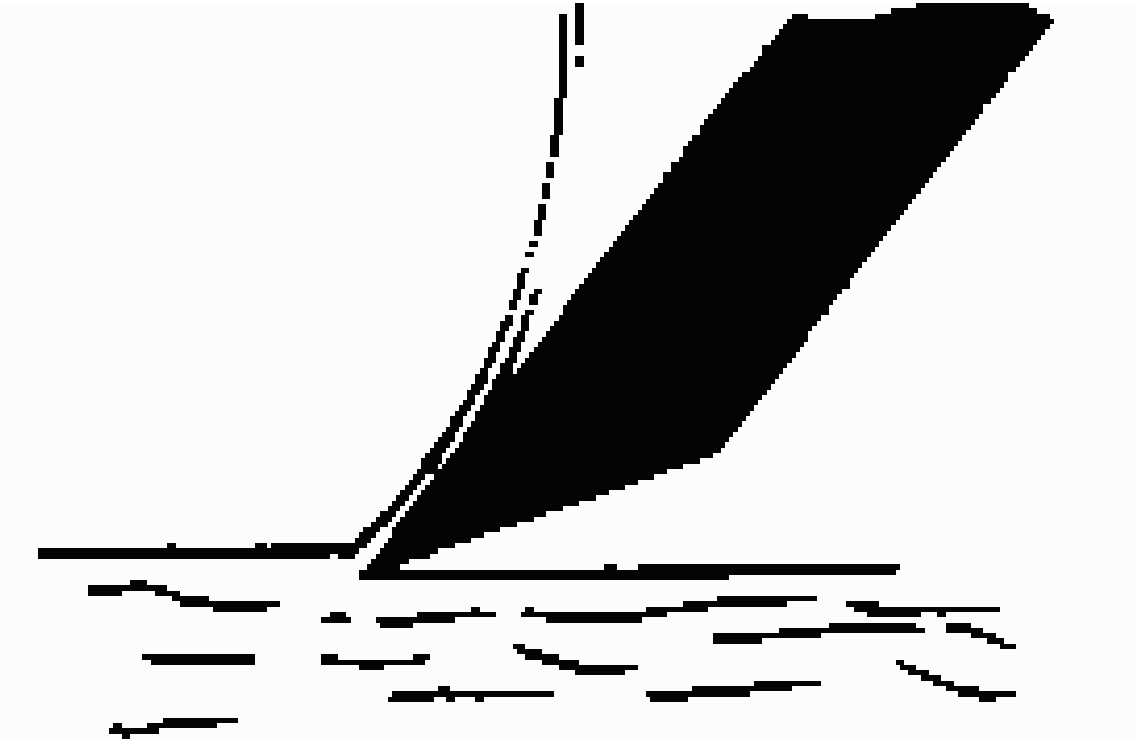
There are Three Types of Cutting Angles: Positive, Negative, and Neutral/zero



Positive Rake Tool



A Positive Rake Tool Lifts/Pulls the Wood Fibers Up



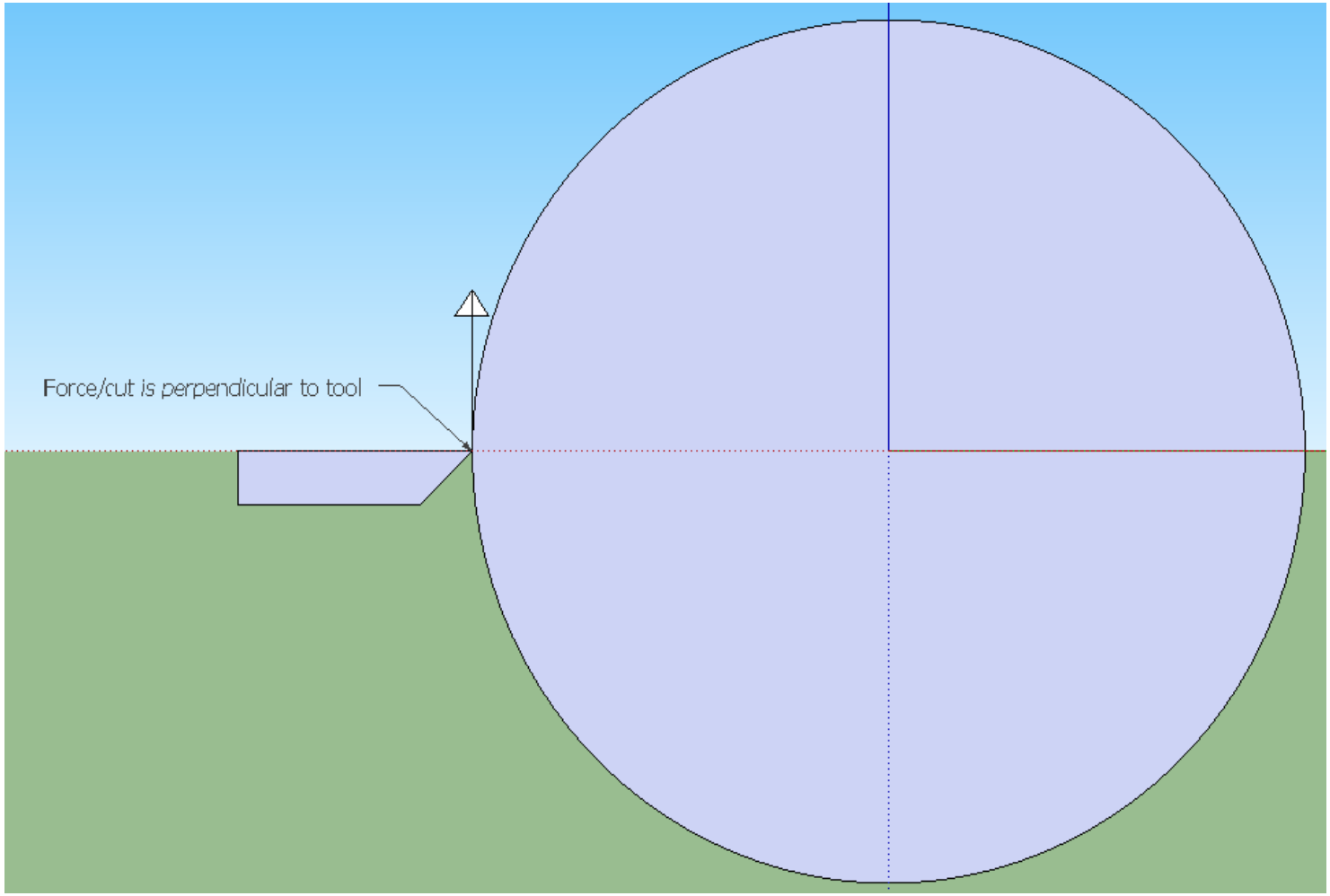
The common belief of the twist on a drill bit is for chip removal, which it does do, BUT the twist gives the cutting edge a positive angle which helps PULL the drill bit into the work piece

Changing the angle/twist of the gouge will give it more/less positive rake which can help reduce the force used to guide the gouge in the work piece.

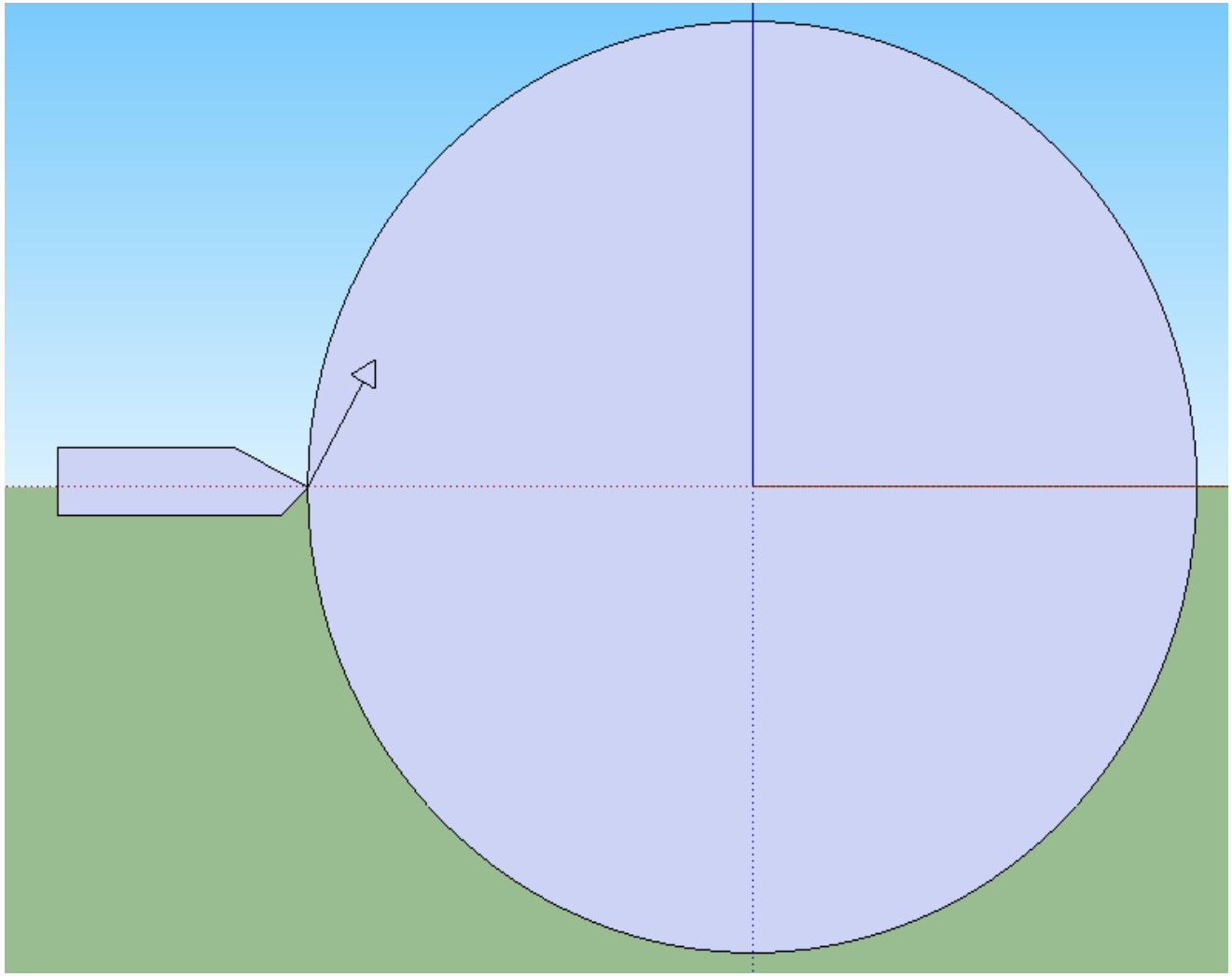
In other words, the positive angle can help pull the gouge into the work piece, reducing the force you apply to the tool making it easier to control.

You should NOT have to force a gouge to cut!!!!!

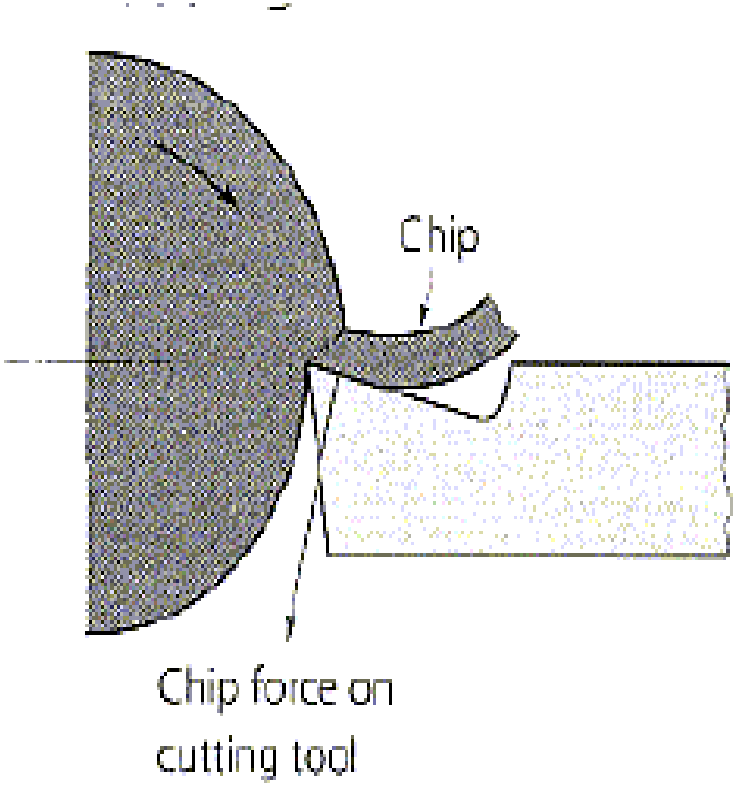
Neutral Rake Tool

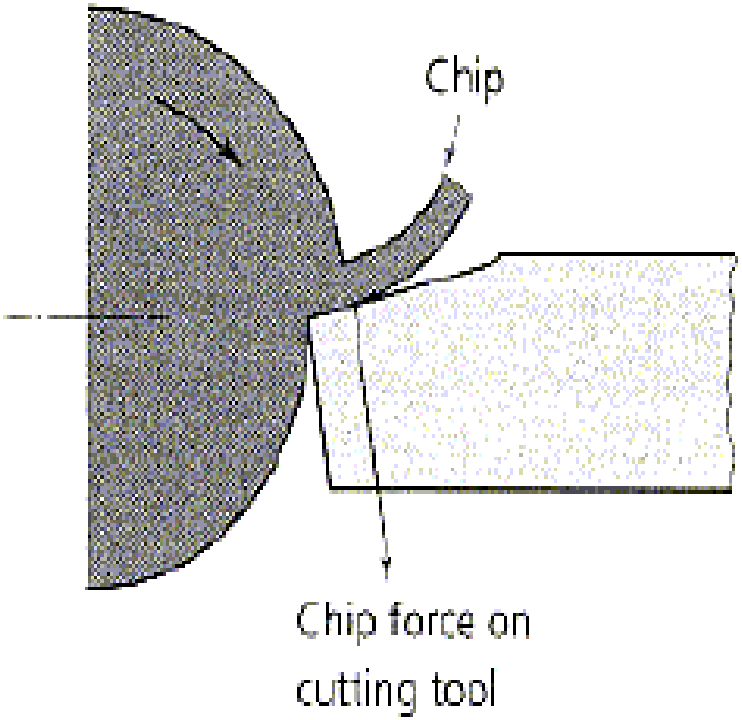


Negative Rake Tool



Notice How The Negative Rake Tool Tends to Push The Chip Into the Work Piece





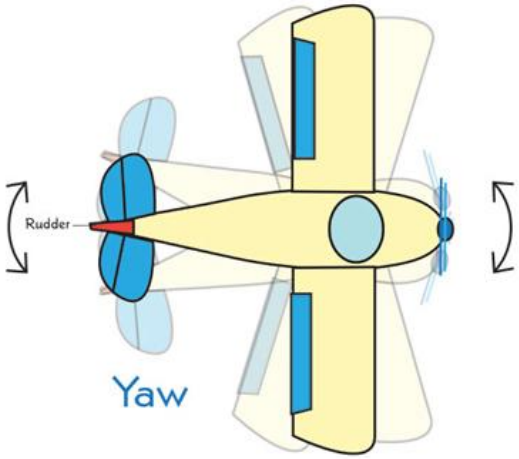
The negative rake tool actually pushes the wood fibers down and with that, the other wood fibers support the others so the fibers can be cleanly cut off.

Using a gouge is like flying an airplane!

In order to get a clean cut, you will probably change the twist and angles to change from scraping, shearing to slicing

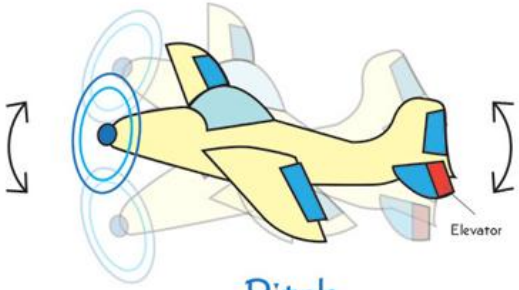
Roll

Use the ailerons to control
Roll



Yaw

Use the rudder to control
Yaw



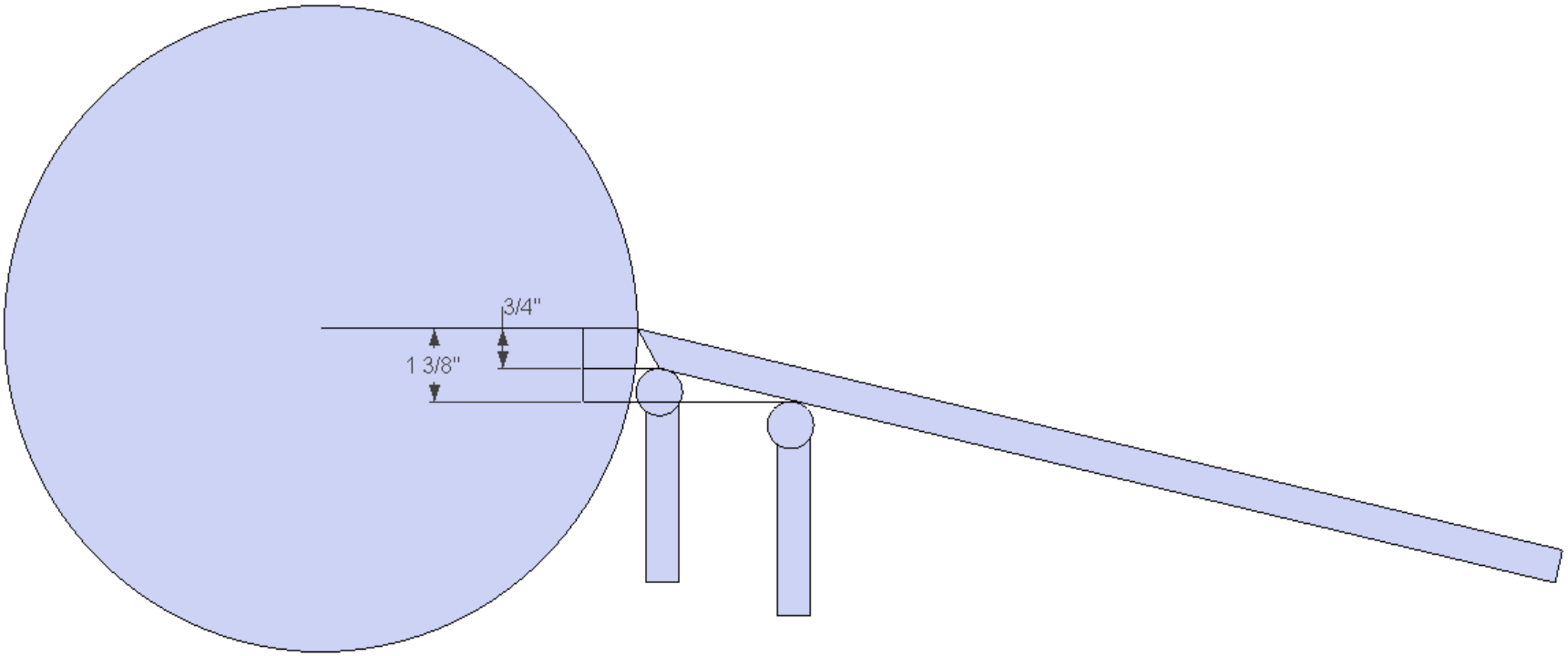
Pitch

Use the elevators to control
Pitch

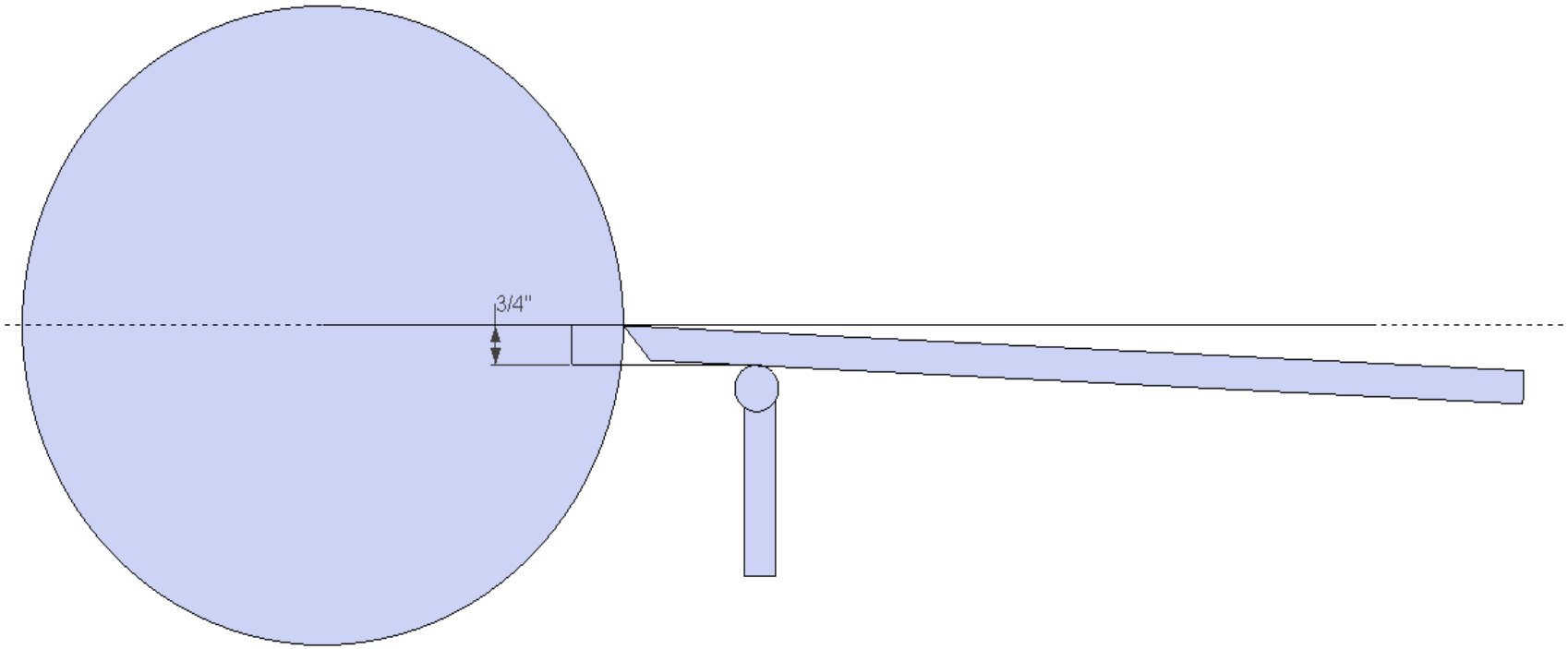
Simply put, there is no perfect angle because it can/will change throughout the cut!
I micro adjust the tool angles all through the cut.

If you keep the tip of the gouge on center, you will have to change the horizontal angle throughout the sweep to keep it on center.

Just consider how the overhang length changes as you sweep over the tool



Notice the shallower angle

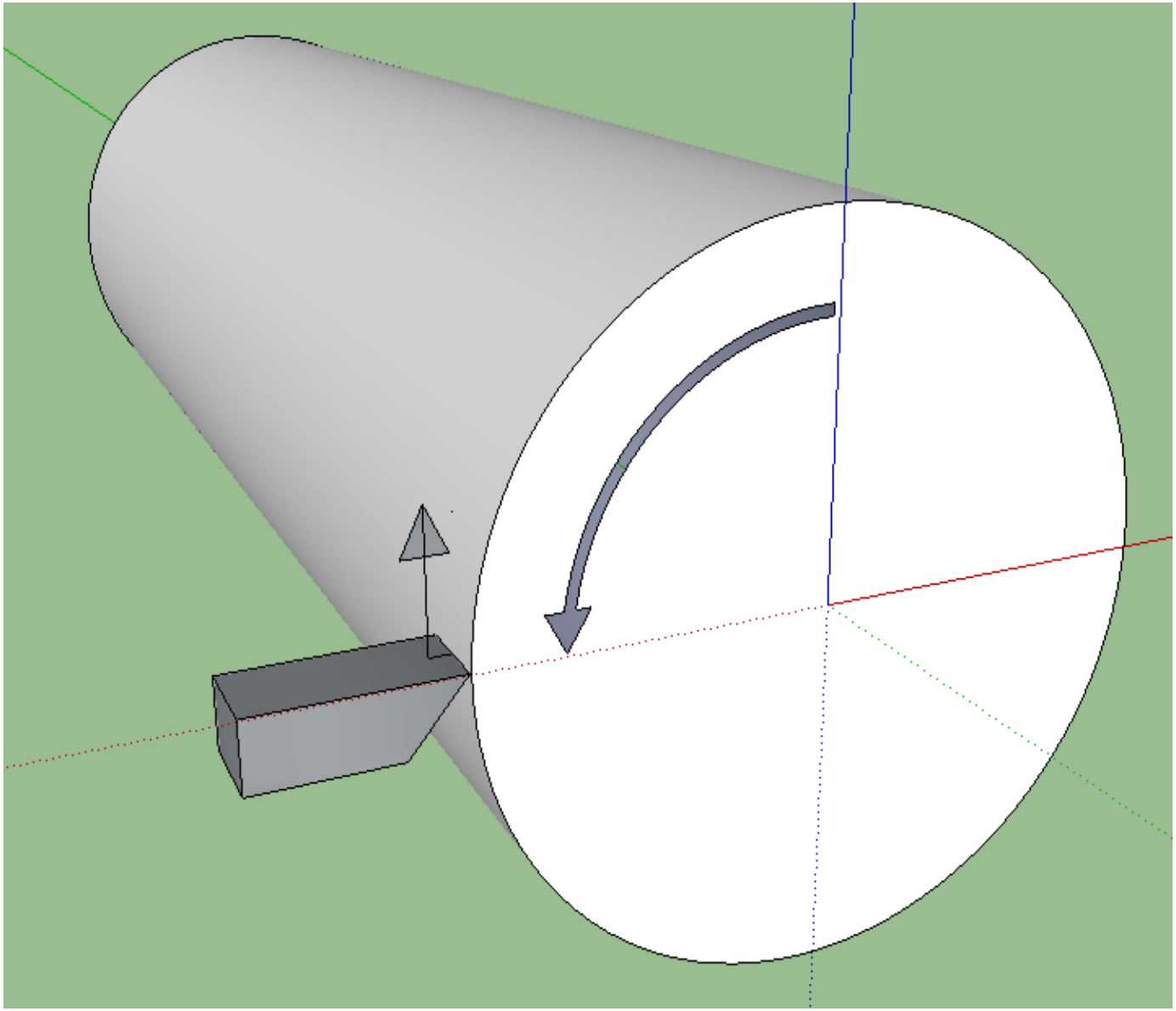


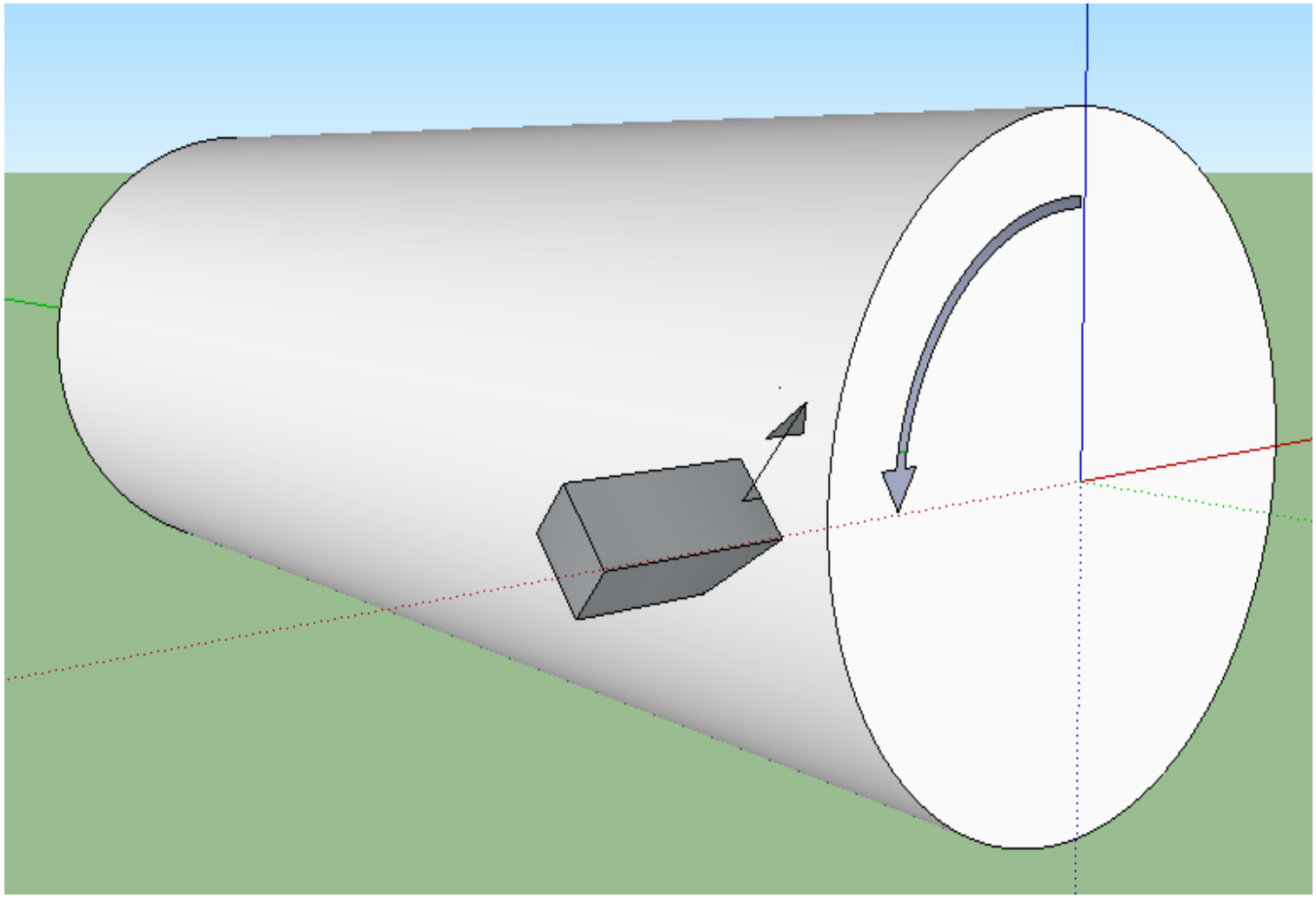
The Cutting Forces That We Are Going to Discuss Are:

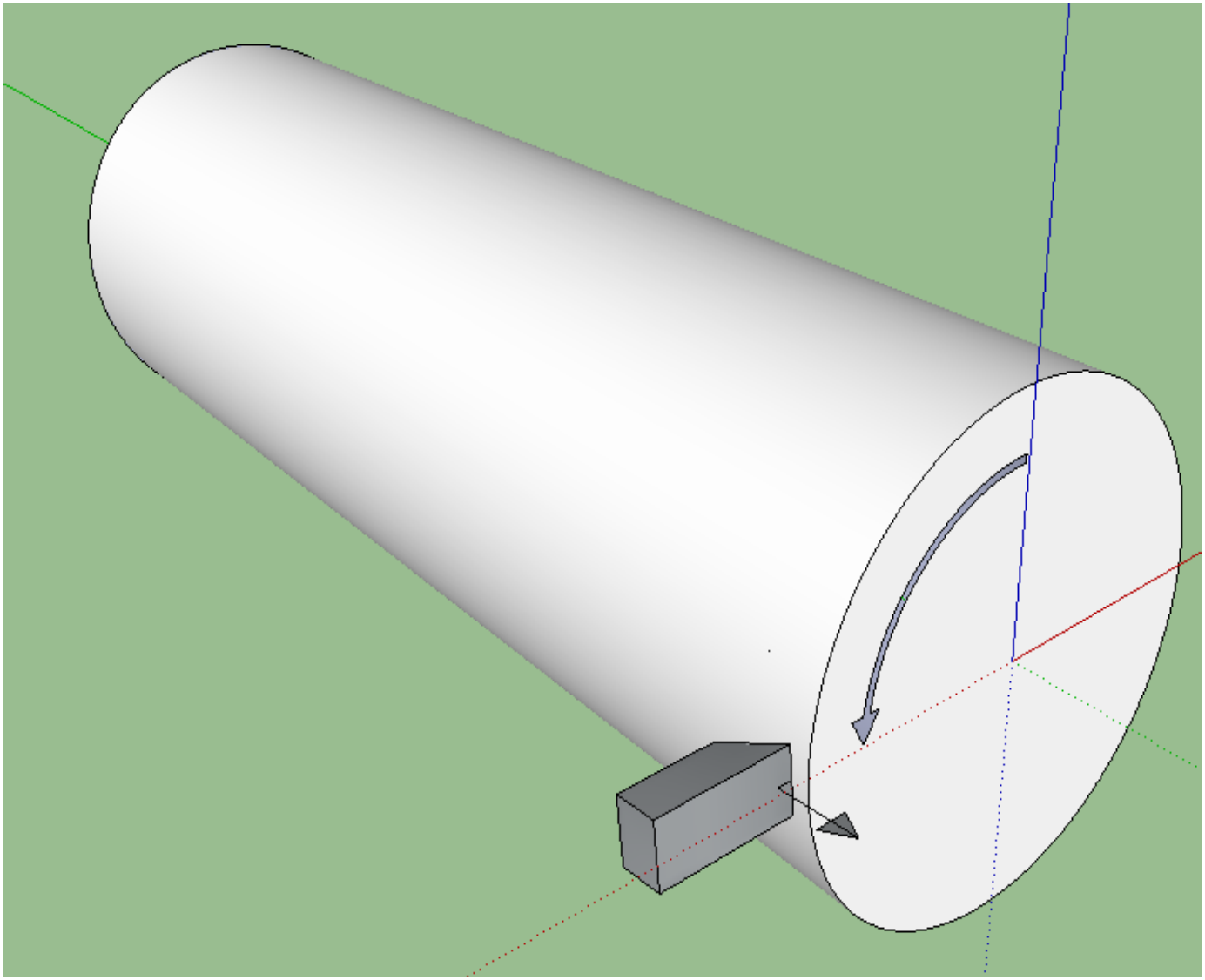
Scraping

Shearing

Slicing

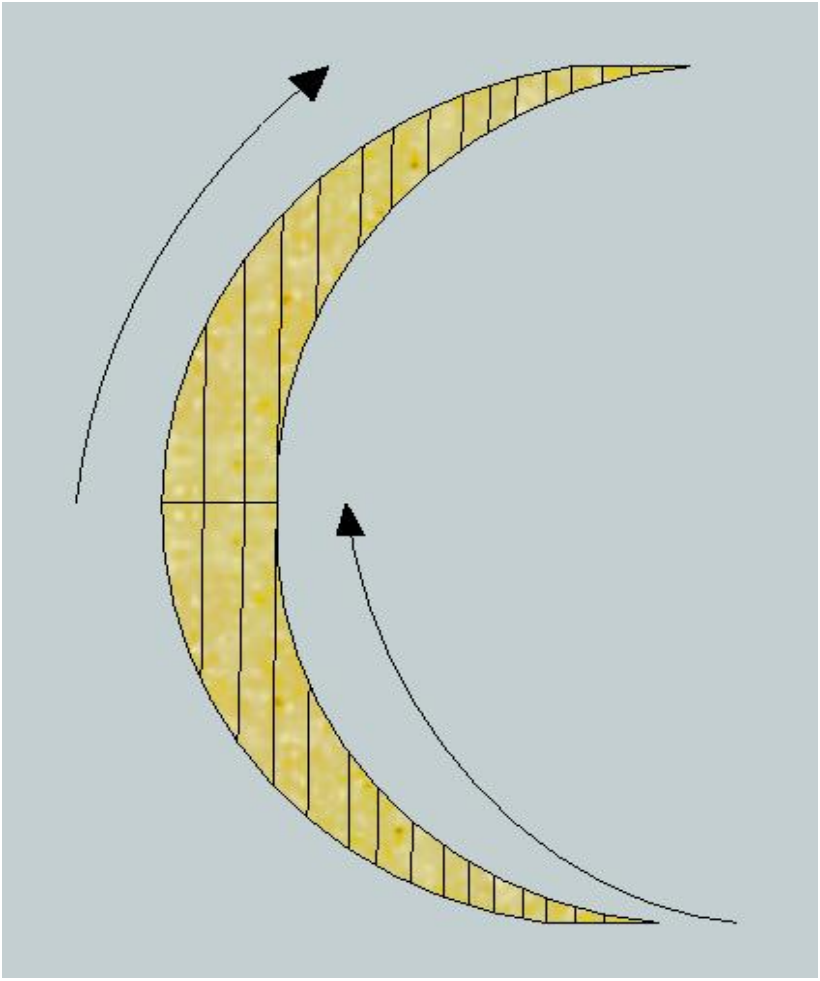




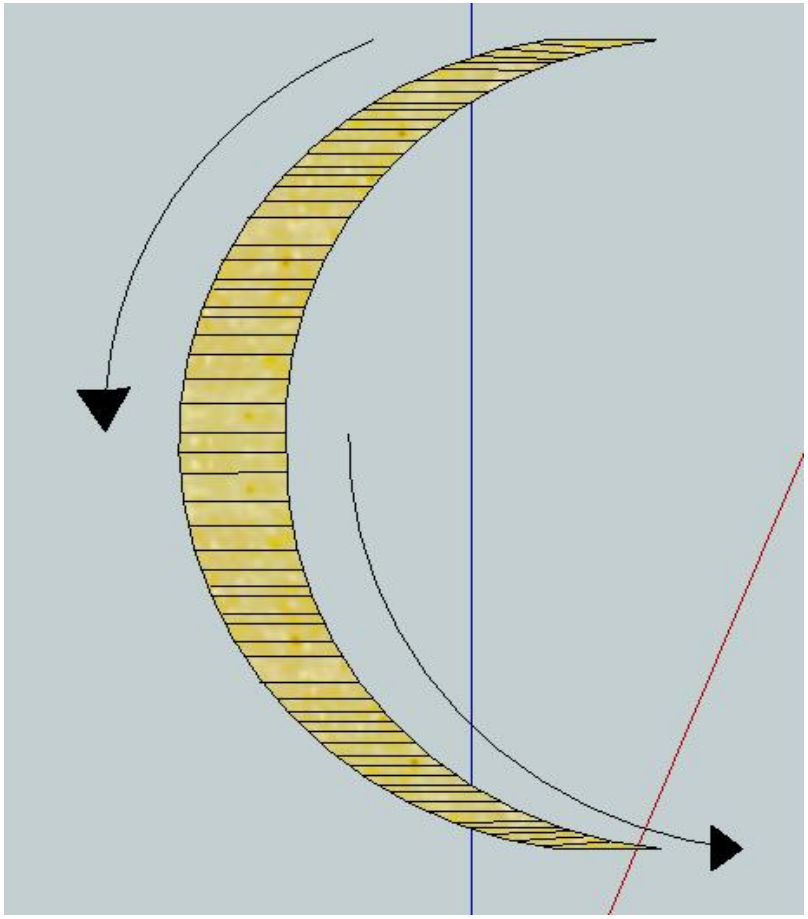


First, you have to consider the grain direction. You should always go WITH the grain, going against the grain causes tear out.

Standard Bowl Grain Direction



End Grain Bowl



I use the gouge with the flute about half open to rough turn. It may be hard to see, but I am rubbing the bevel to control the depth of the cut. Shear Cut.

Notice the positive gouge angle!

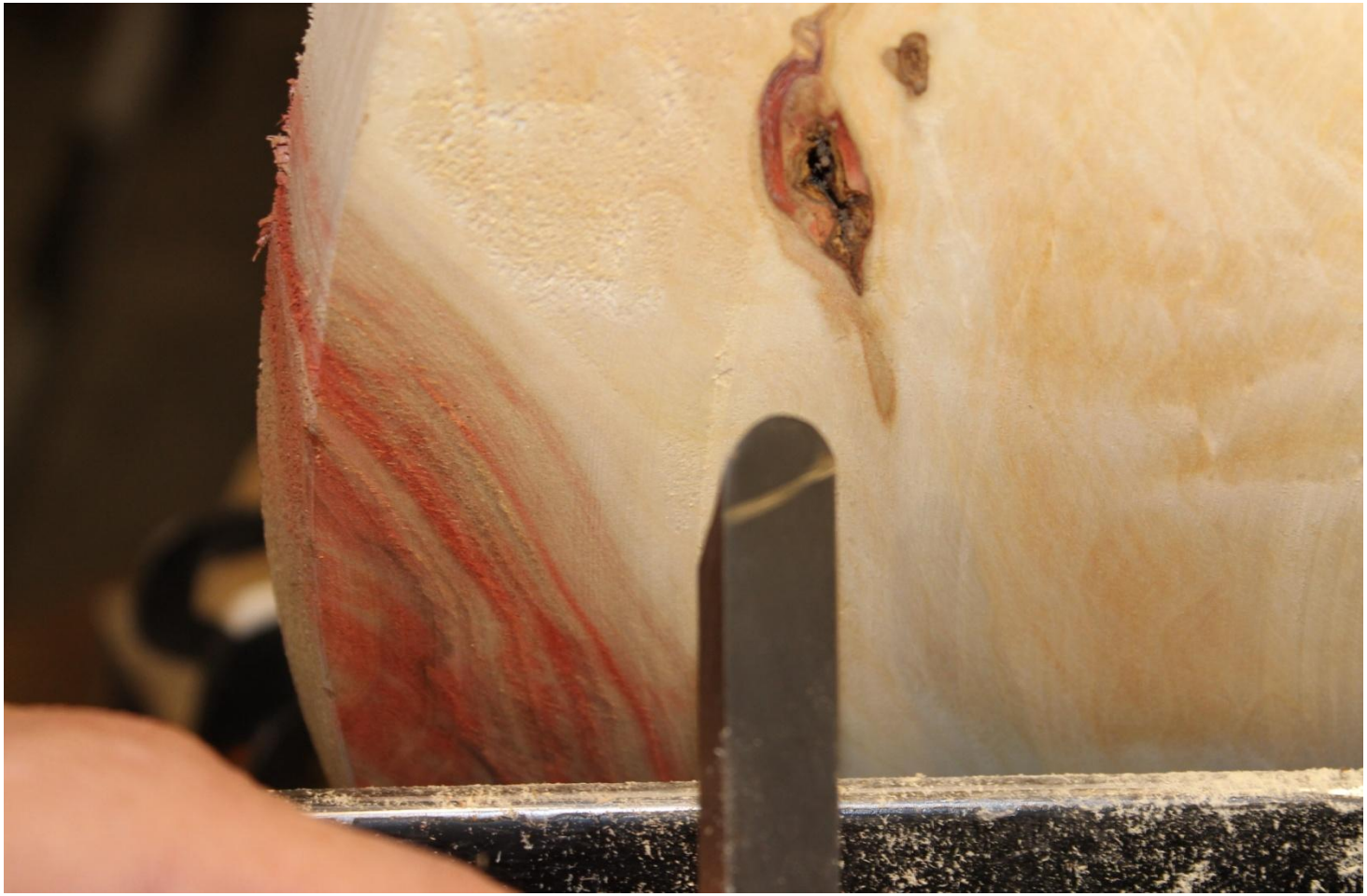
Typical Grain Tear Out With A Shear Cut

By closing the flute, the gouge will slice the wood fibers with the nose radius instead of just cutting them. Notice that the cutting edge is almost parallel to the rotation of the wood. Again, note how I rub the bevel to control the depth of cut. Slicing Cut

After finish turning with the nose radius in the closed position

Now, when you use your bowl gouge, pay close attention to the cutting edge instead of the angle. Turn the cutting edge to the work piece where it will slice through the wood fibers. The angle is then set.

But also remember that a gouge is just a cutting edge



Notice that this is a scraper, only used like a fluteless bowl gouge

By using the cutting edge almost parallel with the rotation of the lathe, The finish is smooth.

And now a detail gouge

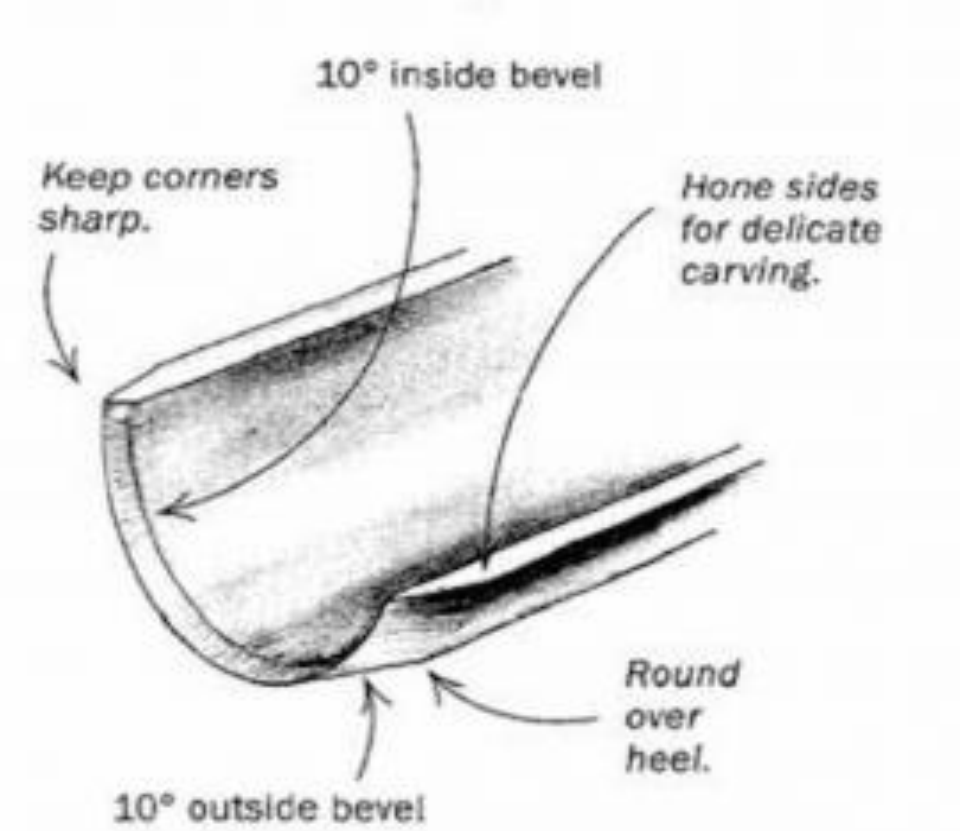
Notice the position/angle of the gouge

Nice finish!

Have you noticed how cleanly a skew chisel cuts? Why?
A skew chisel has a thin knife edge and is used by lining up the cutting edge WITH the rotation of the work piece.

What grind angle is the best?

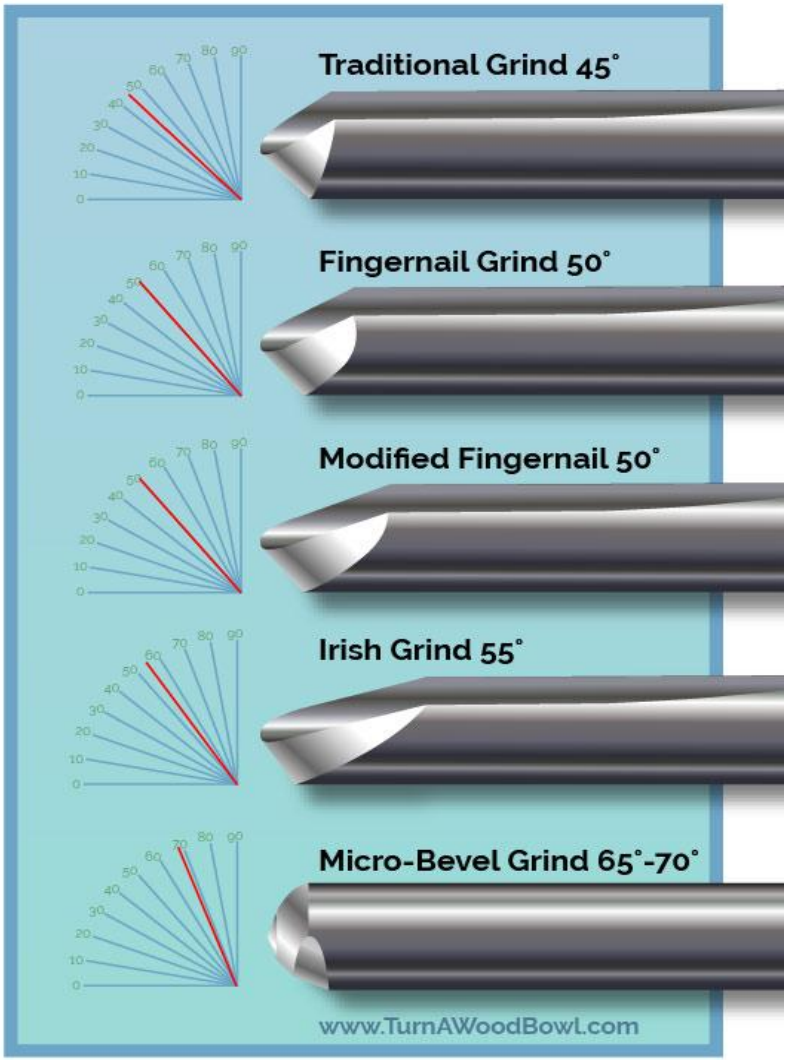
General for carving chisels:



Knives or tool:

Type of Knife or Tool	Recommended Angle
• Cleaver • Machete	30 - 35 Degrees
• Hunting Knives • Pocket Knives • Survival Knives • Sport Knives	25 - 30 Degrees
• Chef's Knives • Kitchen Knives • Smaller Knives • Boning Knives • Carving Knives	18 - 25 Degrees
• Fillet Knives • Paring Knives • Razors • X-Acto Knives	12 - 18 Degrees

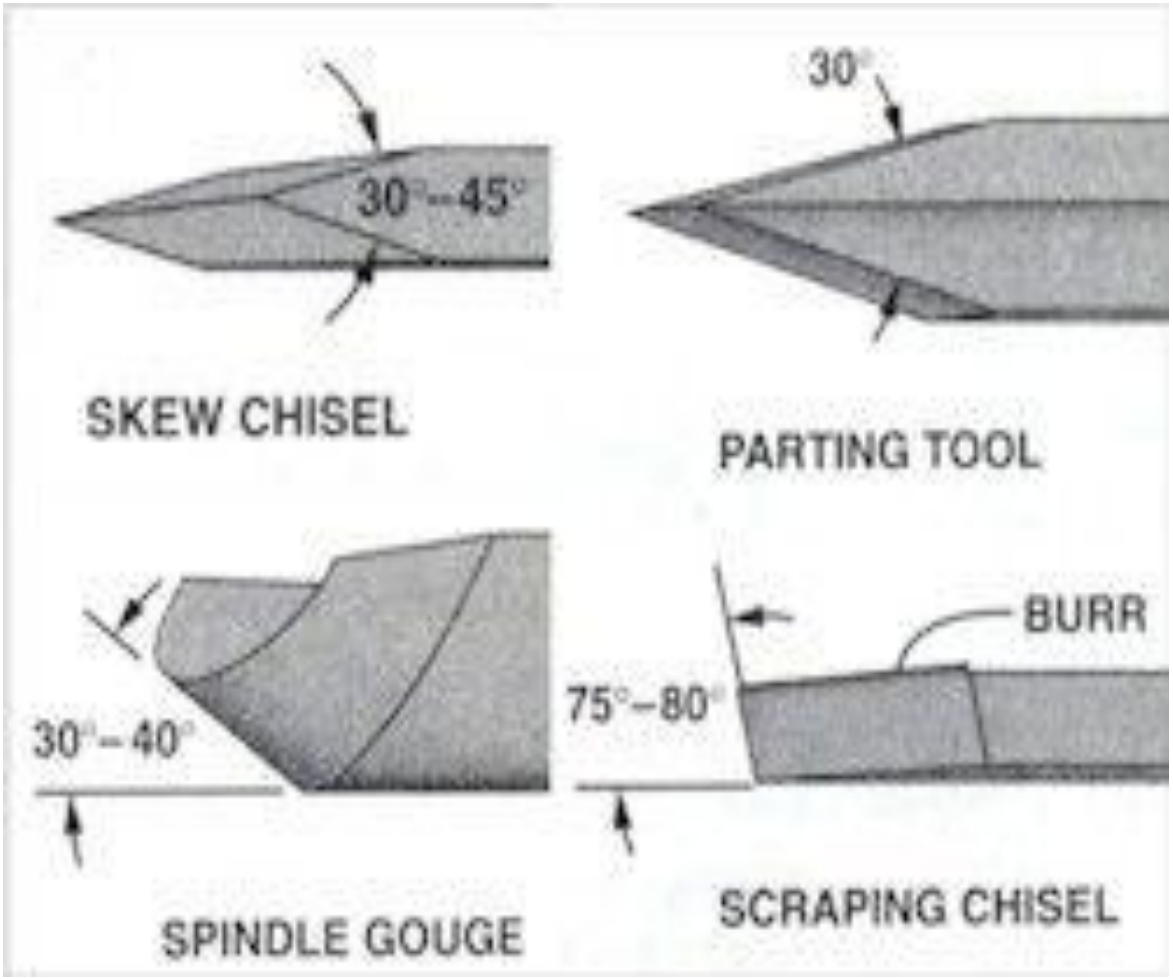
How about Bowl gouges?



Or the Stuart Batty 40/40?

What I have observed is the best angle is what you get used to. It is not an absolute.

Spindle Gouges

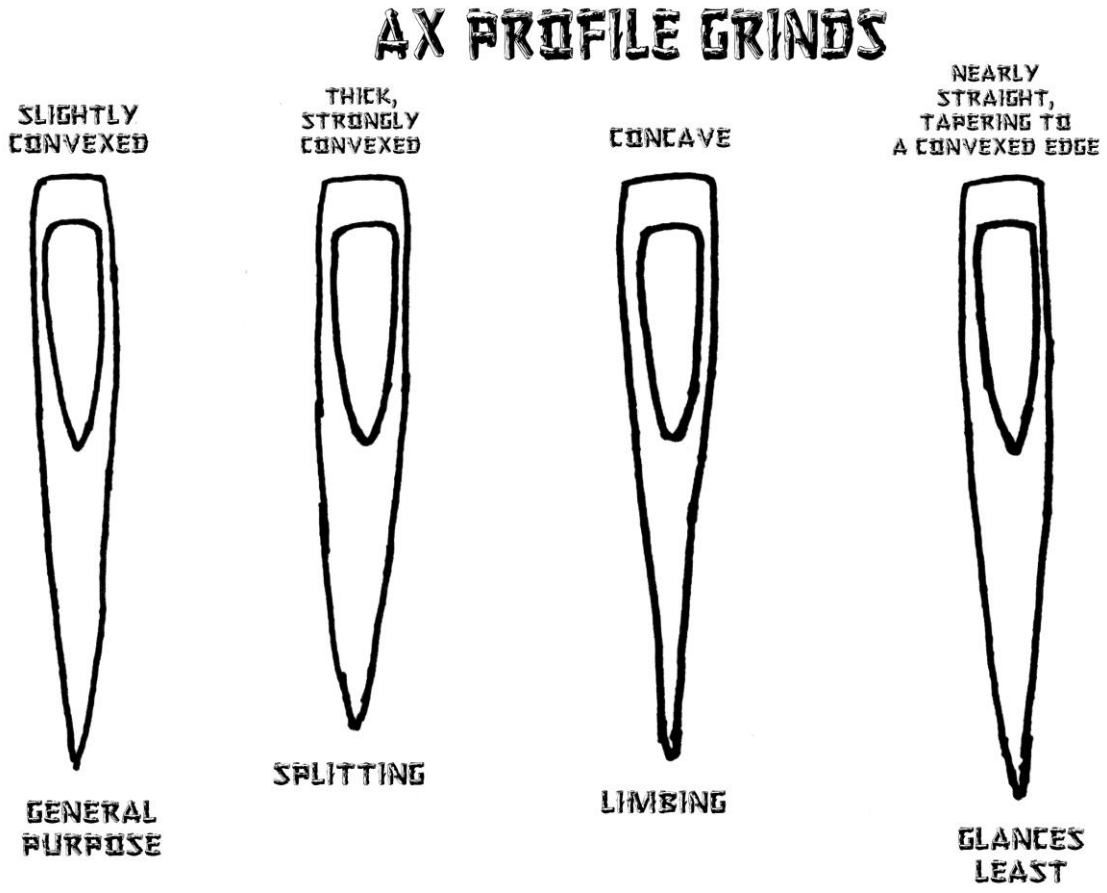


Sure is confusing isn't it?

It boils down to this: It is mostly what you are used to balancing where it is going to be used and how tough you want the cutting edge needs to be. The more blunt the cutting edge is, the longer it stays sharp, but the more extreme the angle, the better to get into narrow cuts and the more slicing capability it has.

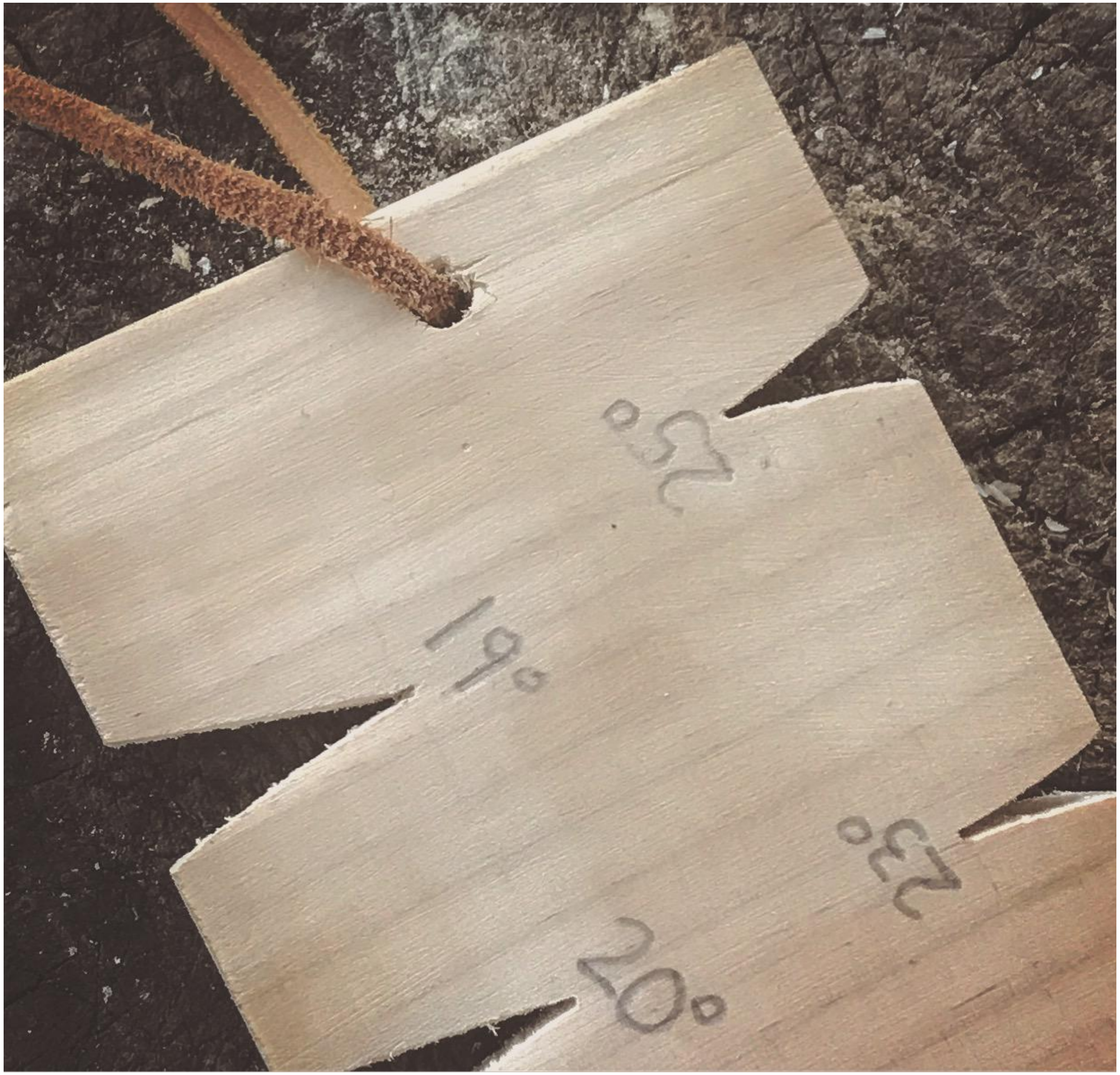
Okay, is it a 50 degree angle or 40 degree angle? That depends on where zero is on the protractor. In reality, they are the same depending on how they are measured.

The angle of the cutting edge



When sharpening your axe be mindful of the bevel or angle at the bit end. An axe is not a straight consistent wedge. The angle of thickness is different as you move up the axe bit. Most axes have a 30° -40° degree angle at the end of the bit and a **15° -20° degree angle about ½" from the cutting edge.** The bulge away from the end of the bit is what provides the axe its splitting power.

https://www.bnctools.com/pages/axe-sharpening


19°
20°

When you need to make a finish cut and you are having tear out problems, remember the shape of the cutting edge.

Think of the difference between a splitting maul and an axe.

The splitting axe has a broader angle on the cutting edge

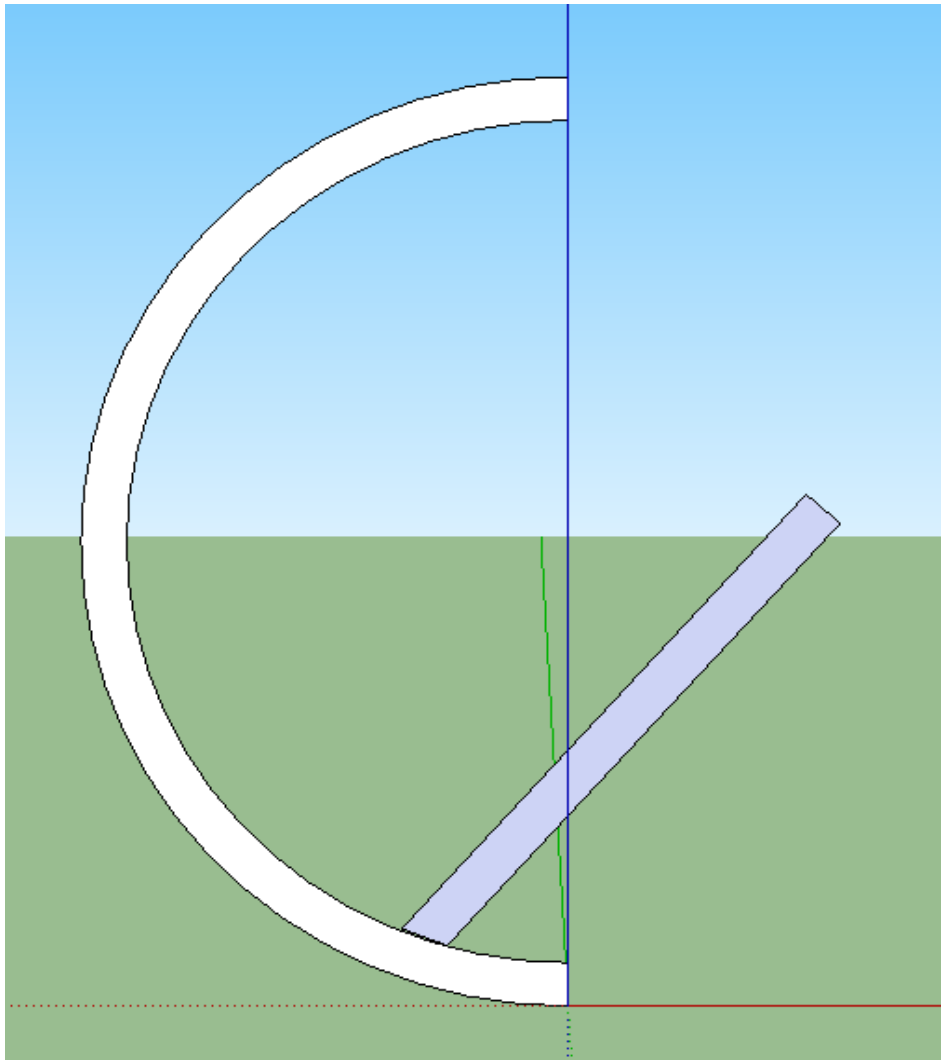
The axe is much more thinner like a knife.

So, what is the perfect angle? It depends on who you talk to or what you are used to. Think of the different angles on axes, knives, carving chisels, hand planes and/or wood chisels.

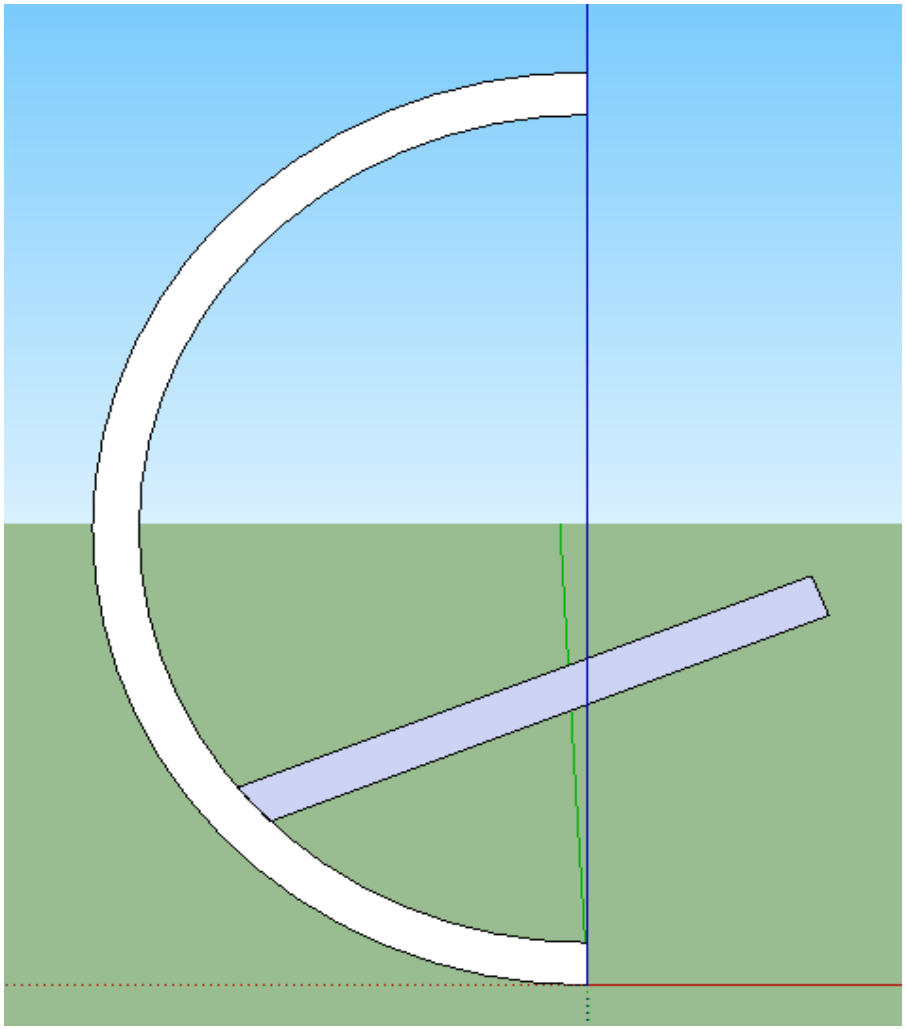
To me, it makes sense that the sharper the cutting edge/angle, the more effective the cutting action, but other factors have to be considered.

For one thing, the sharper the angle, 15° versus 30° means that the sharper angle will dull more quickly

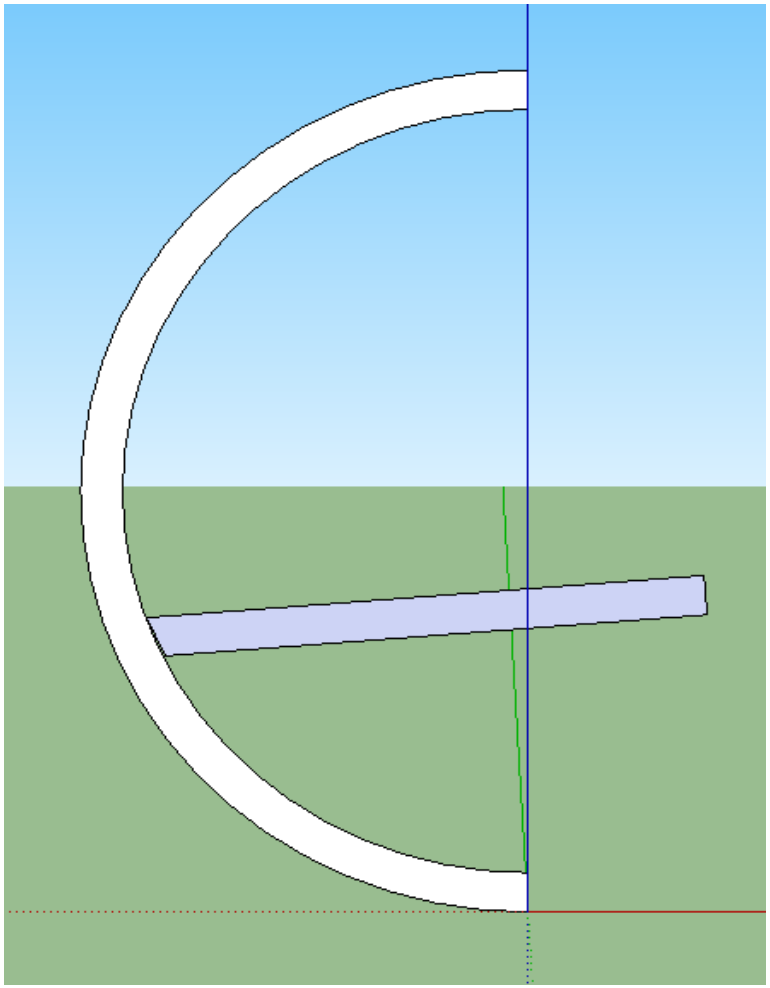
Bowl gouge with 30° Nose angle



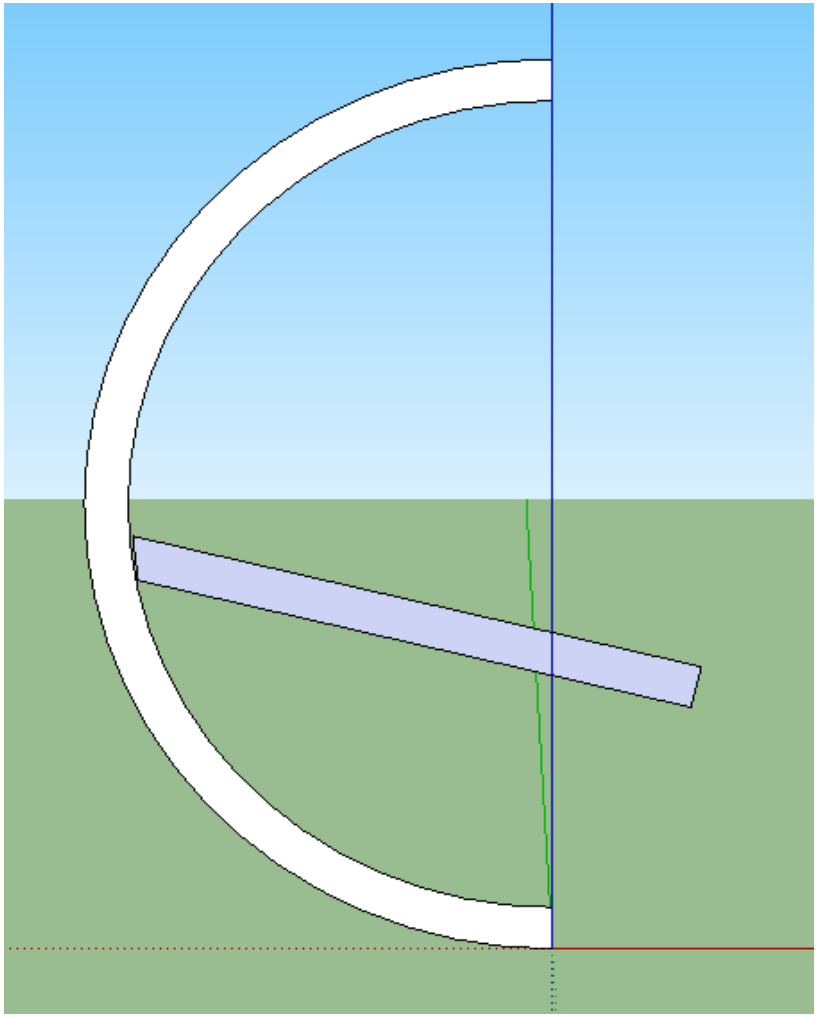
½ way through the cut. Notice that the tool is well away from the side of the bowl



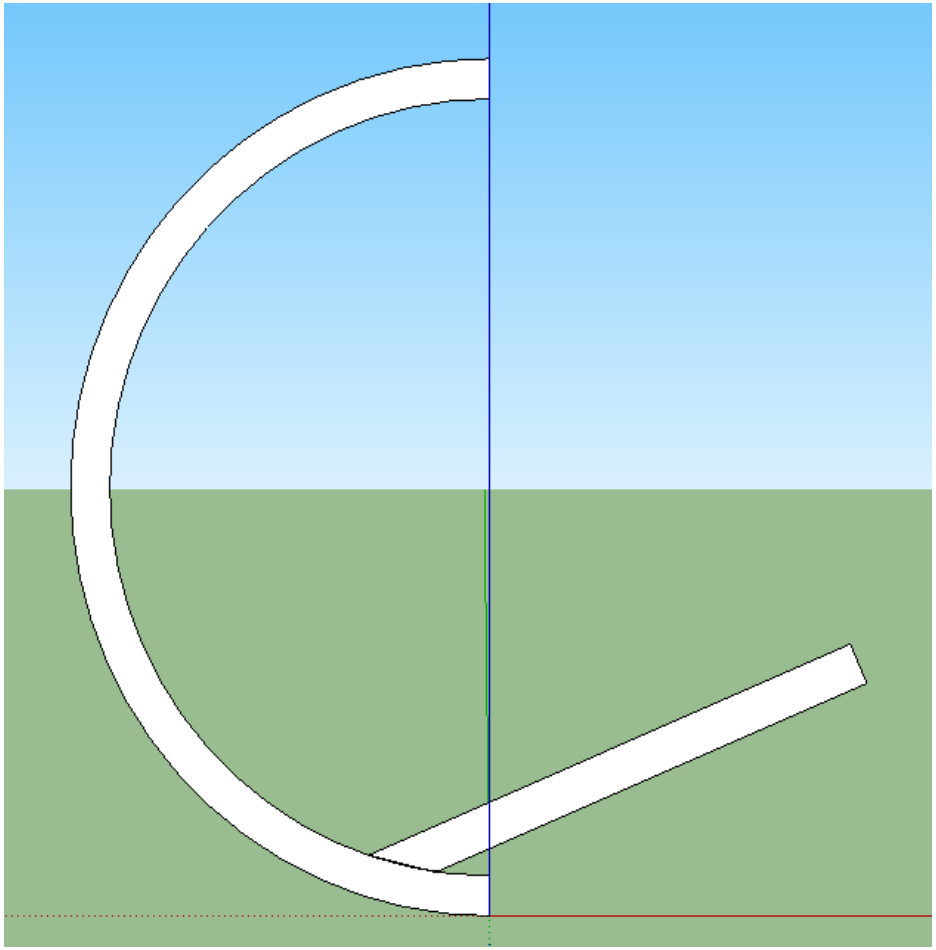
Notice that the tool is still well away from the side of the bowl



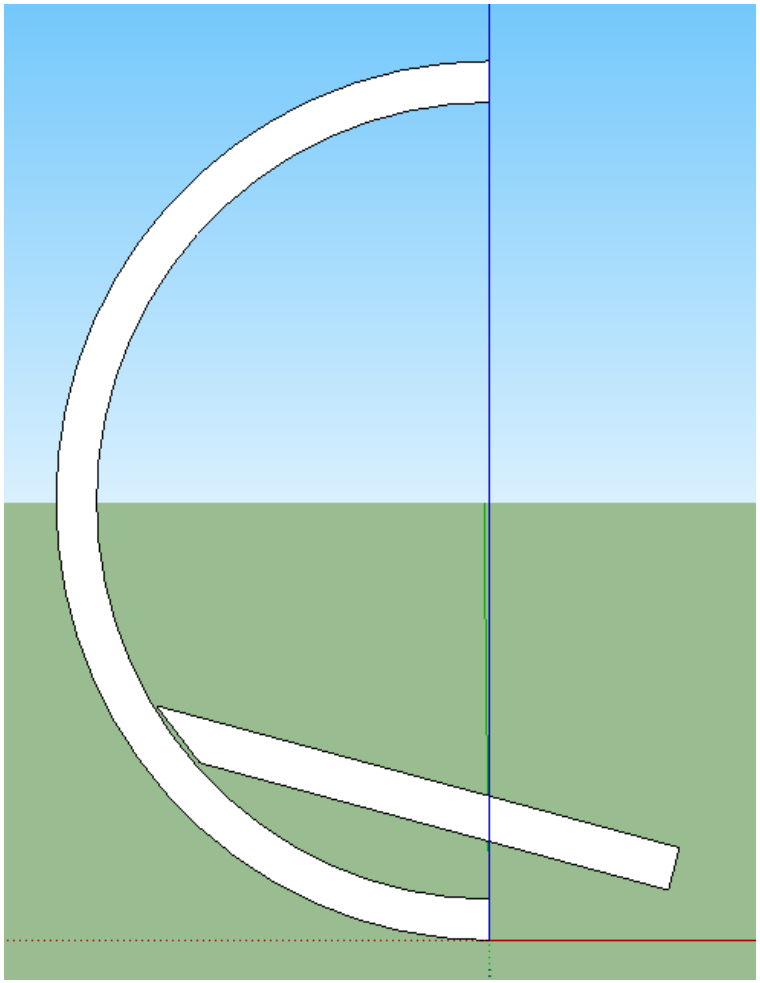
The cut is almost complete and the tool is still away from the side of the bowl



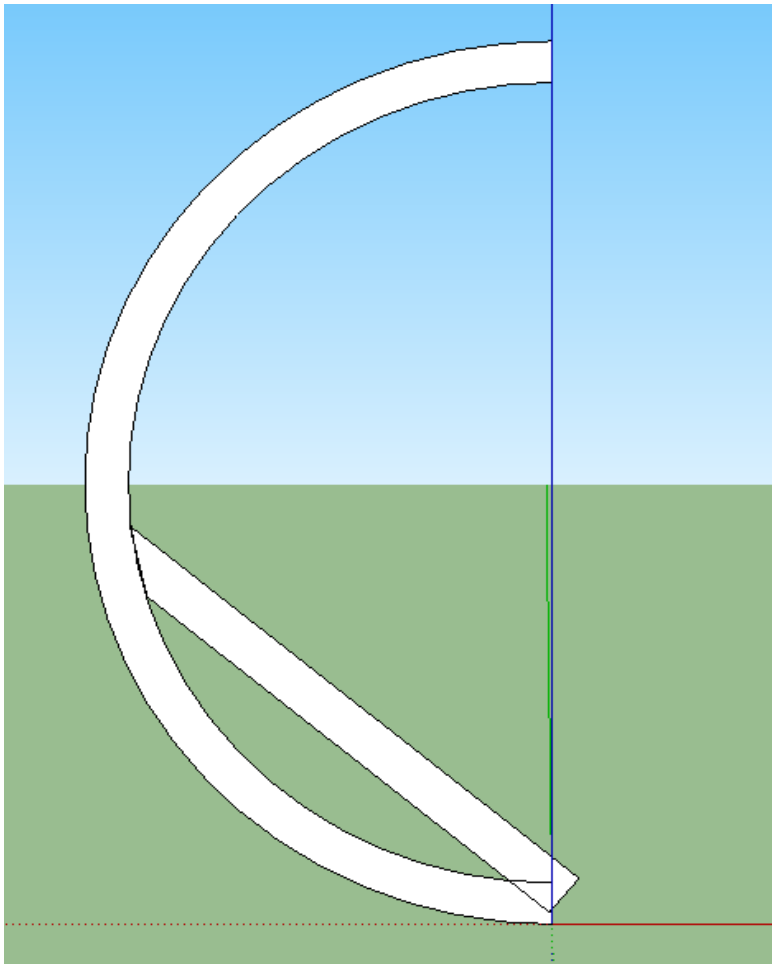
Now a tool with a 60° nose angle



The tool is ½ the way through the cut and notice how close it is to the side of the bowl



Now the tool is almost to the bottom of the bowl and is rubbing the side of the bowl. It can not complete the cut



The nose angle of a bowl gouge is usually around 30° to 45°

But the angle of the wing, sometimes called the “cheeks” cutting edge can be as slim as 25° or so, just like the difference between a splitting maul and an axe.

Using the nose with the flute closed works, but here is another way

It is a lot harder to control the tool, but it leaves a nice finish

Honing a gouge!

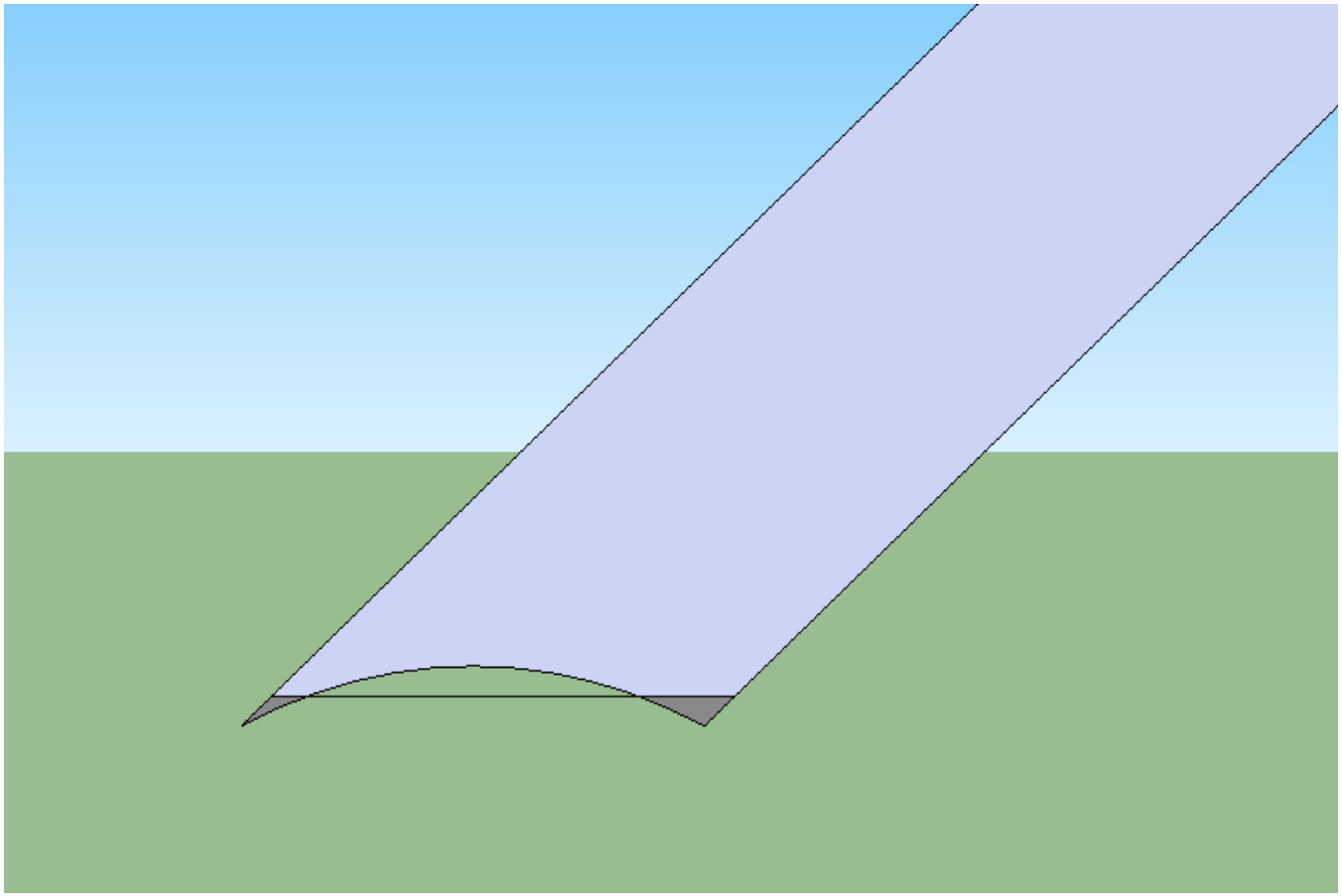
There are three the types of bevels

A. Hollow ground/concave

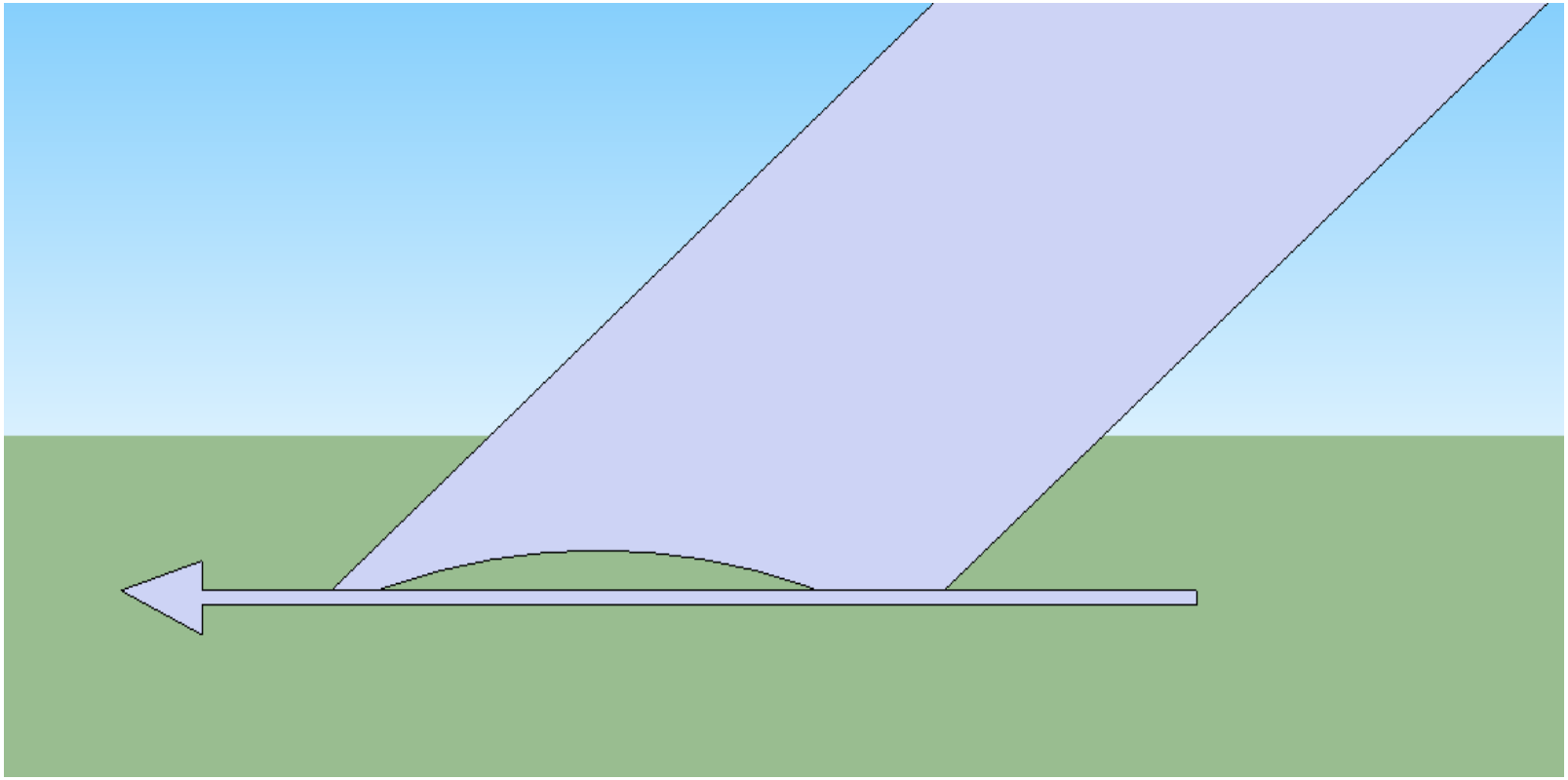
B. Flat

C. Convex

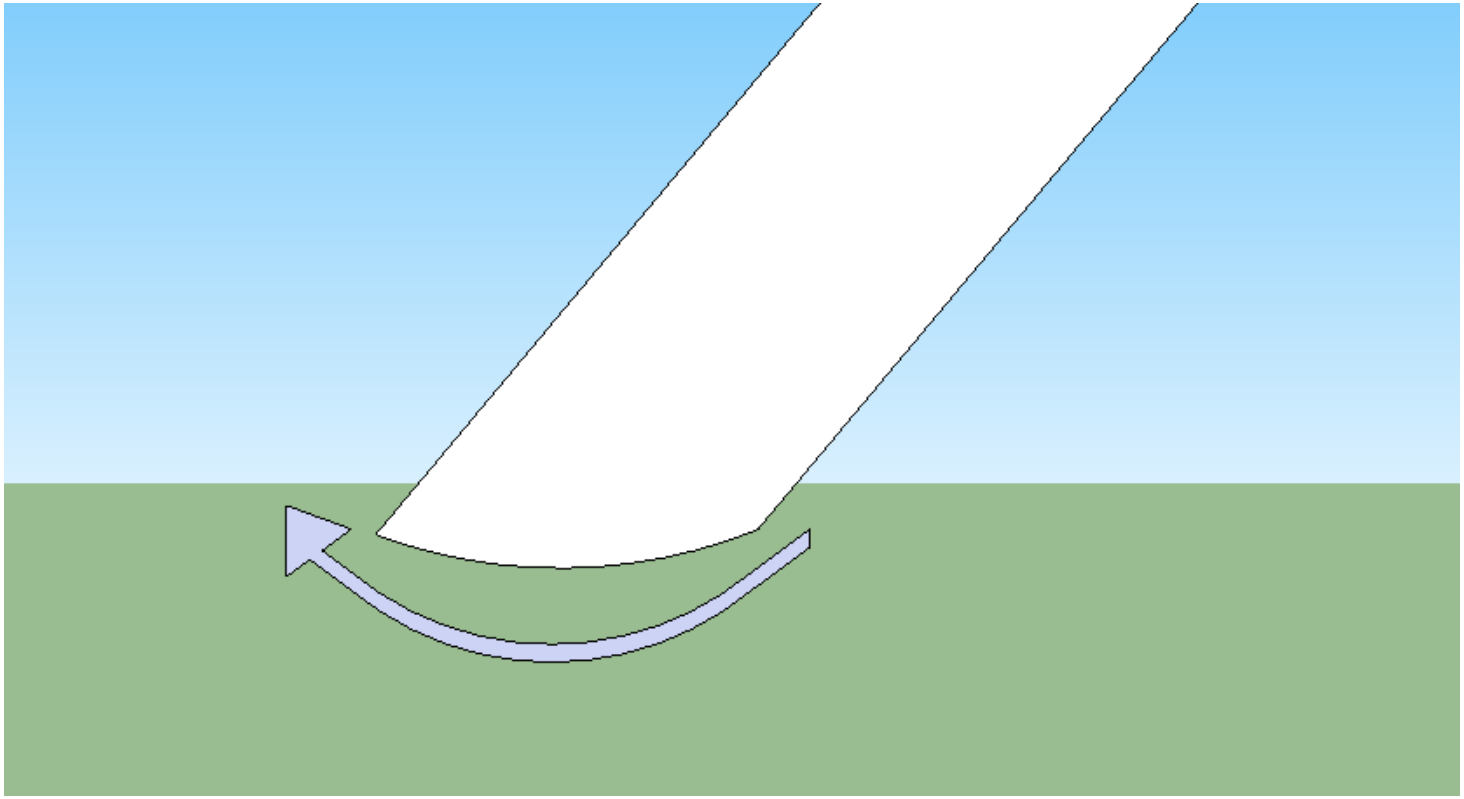
When you hone a bevel, you remove metal front and rear changing the radius to a flat bevel.



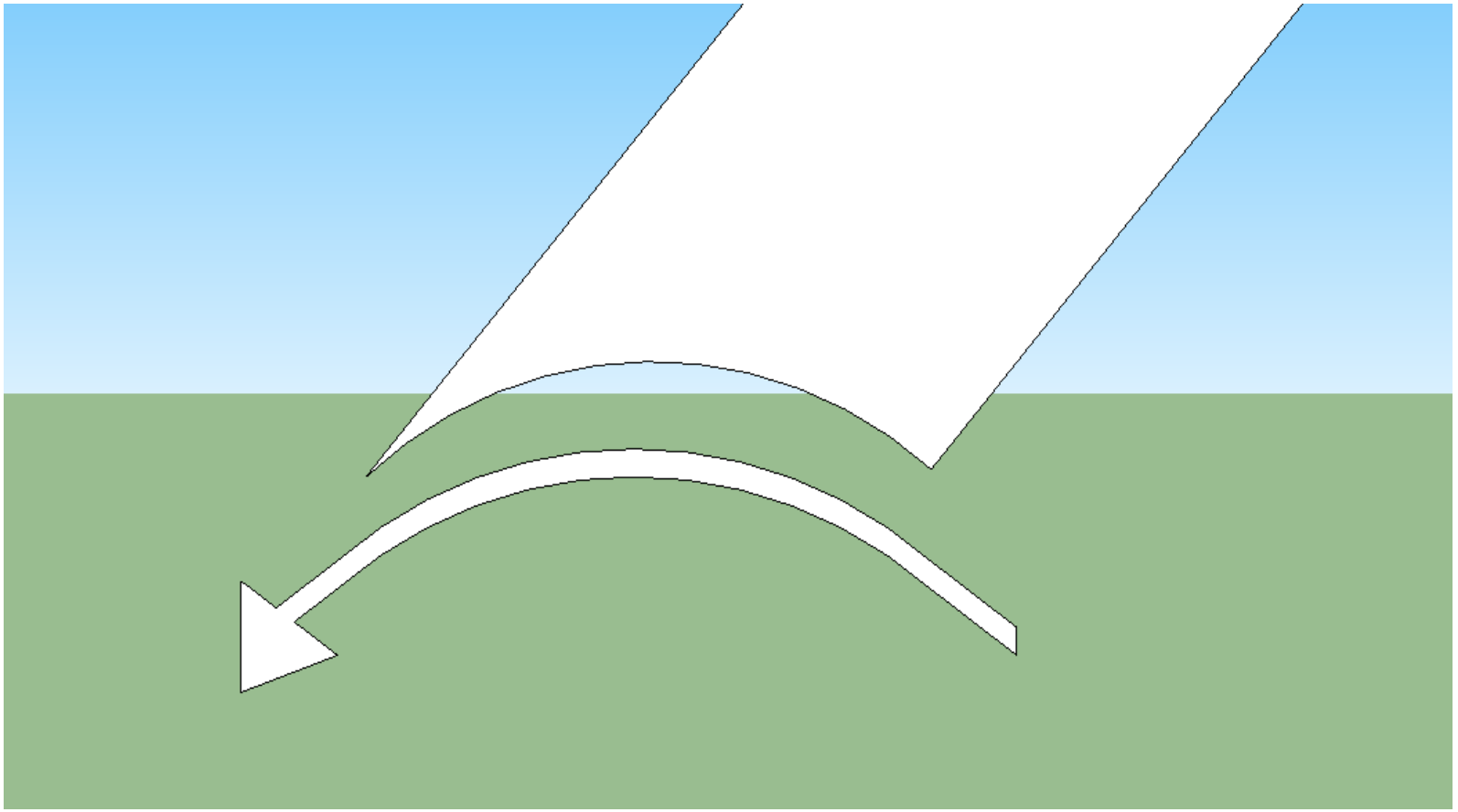
Notice that honing changes the cutting action. Instead of digging in, it will move straight ahead. It is still sharp, it just cuts (feels) different.



Much less used is a convex grind bevel, but it has an advantage; it works like a carving chisel. It wants to move up and out of a cut.



(Exaggerated hollow grind bevel)
Notice that the hollow grind wants to follow a radius into the work piece.



Long Bevel

With a long hollow ground bevel, there is more chance of a dig-in or catch due to the geometry

The void between the cutting edge and heal of the bevel wants to make the cutting edge dig in

This can be an advantage as well as a disadvantage!

Micro/Secondary Bevel

A micro bevel is nothing more than a primary bevel with a secondary bevel. It is not magic, it just serves a function.

Secondary Bevel

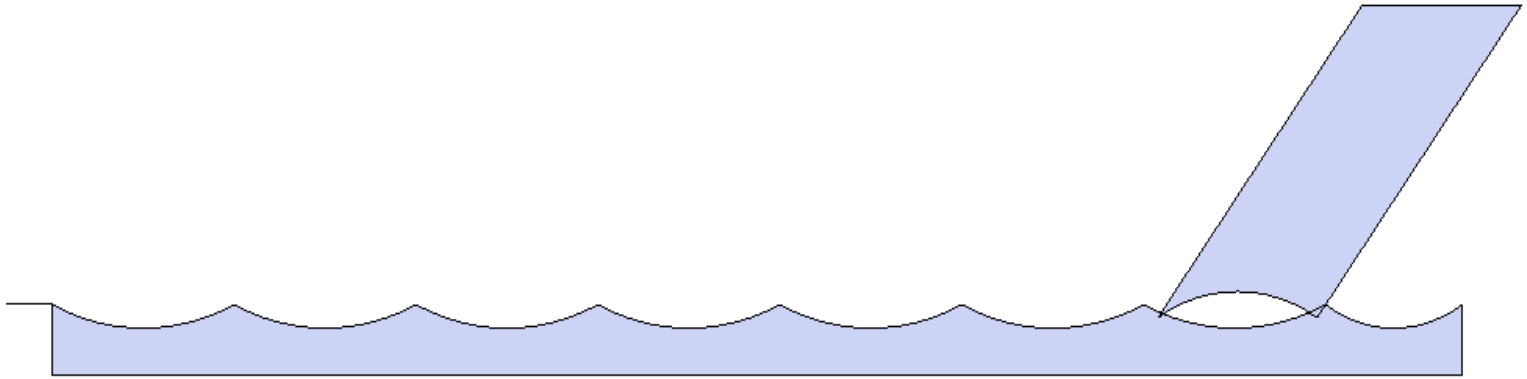
The function of a secondary bevel is only clearance

If it clears by and inch, it is as good as a mile so the angle is irrelevant.

But a secondary bevel has a huge advantage in that it will overcome the washboarding which can occur on an inside curve as in the inside of a bowl, but can also occur anywhere a vibration/ripple might happen

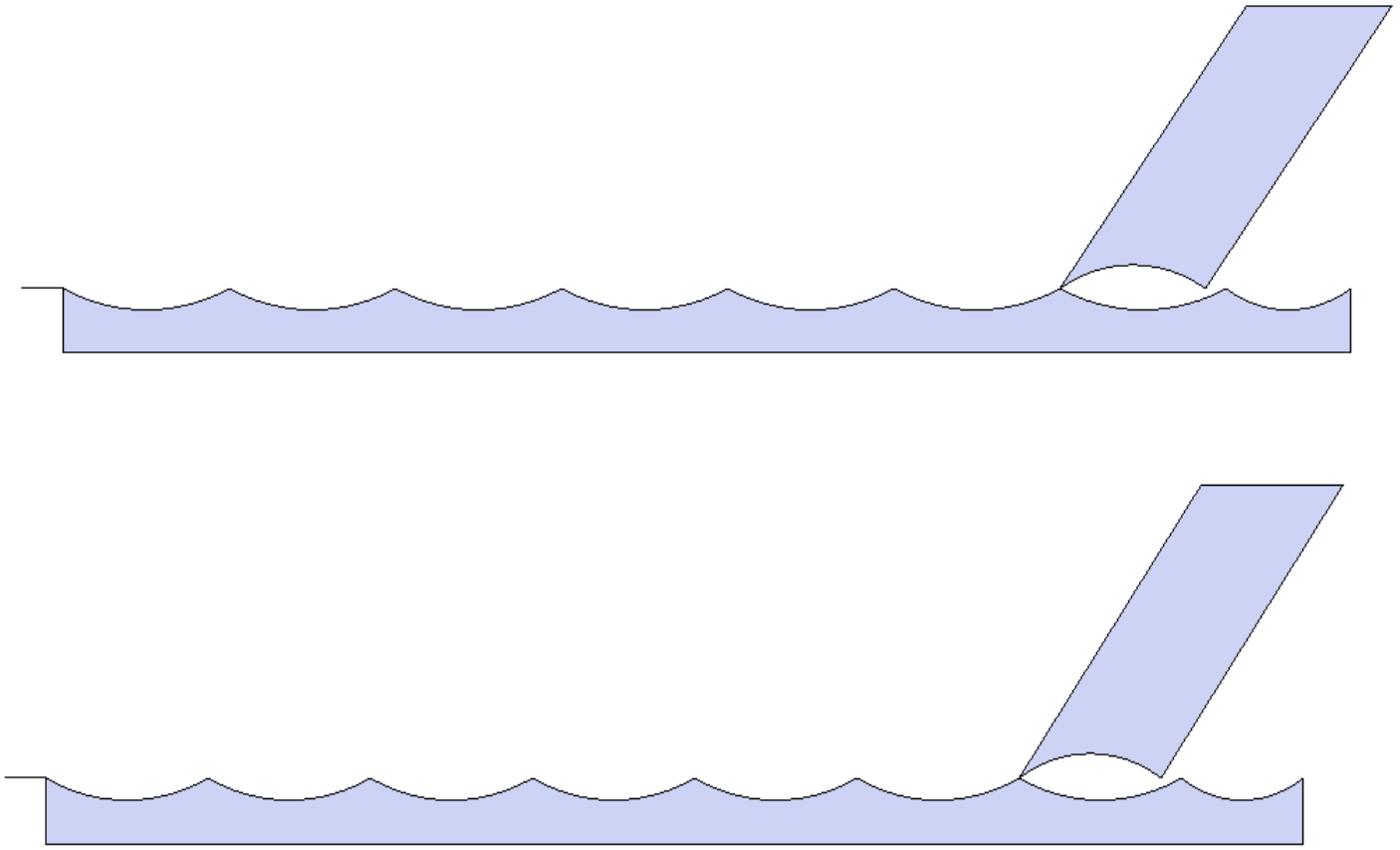
The problem with long bevels

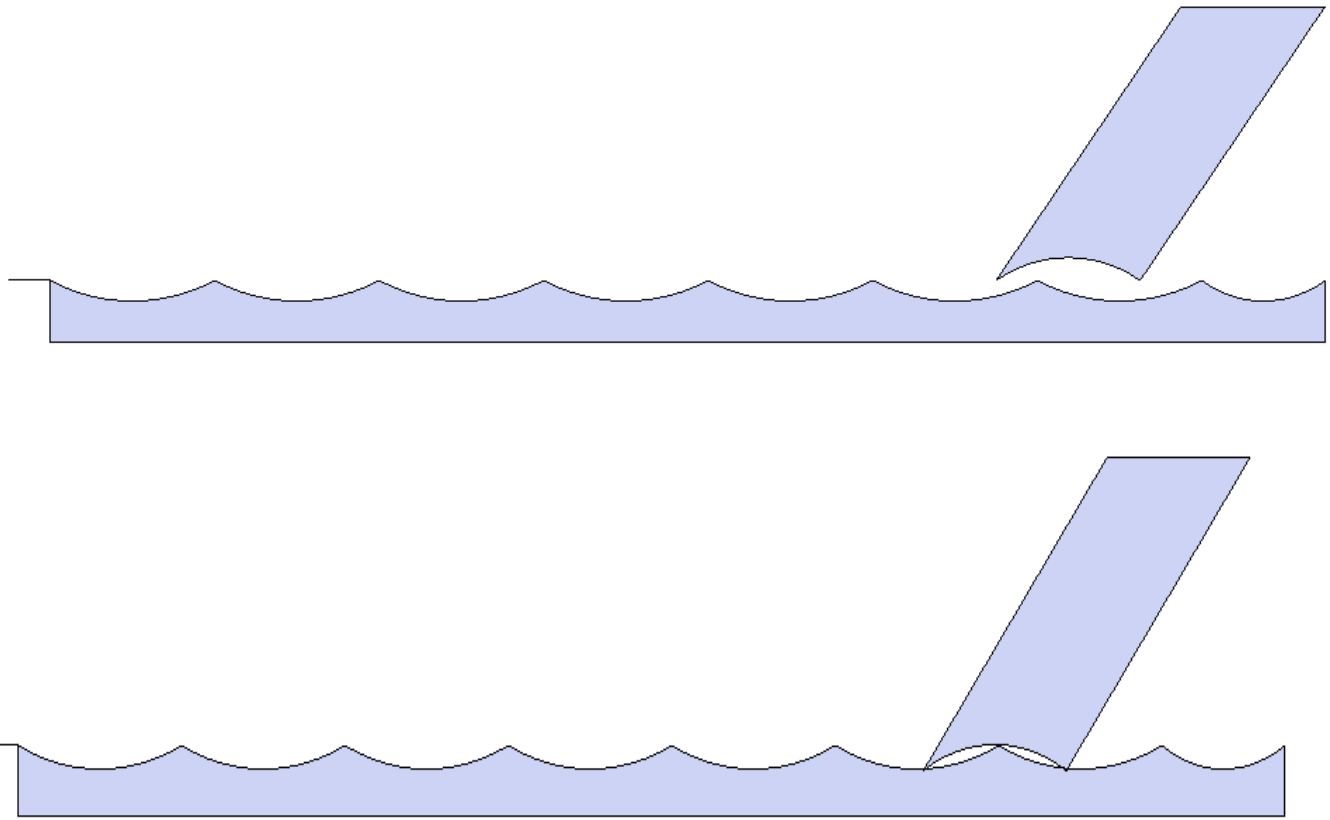
Illustrations are exaggerated for clarity



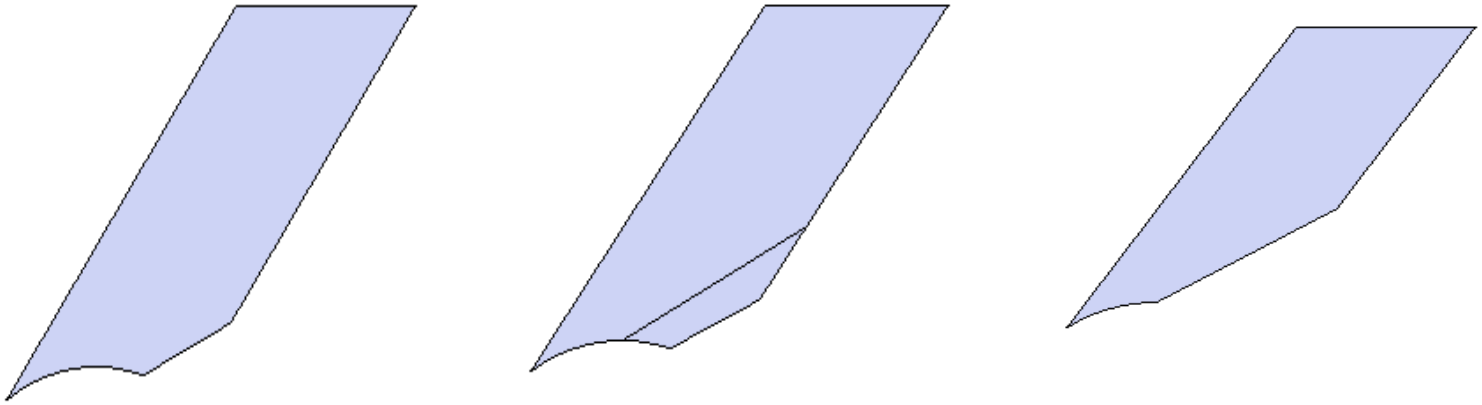
The long bevel and hollow grind will rise and fall with the washboard tool marks

The long bevel and hollow grind will rise and fall with the washboard tool marks

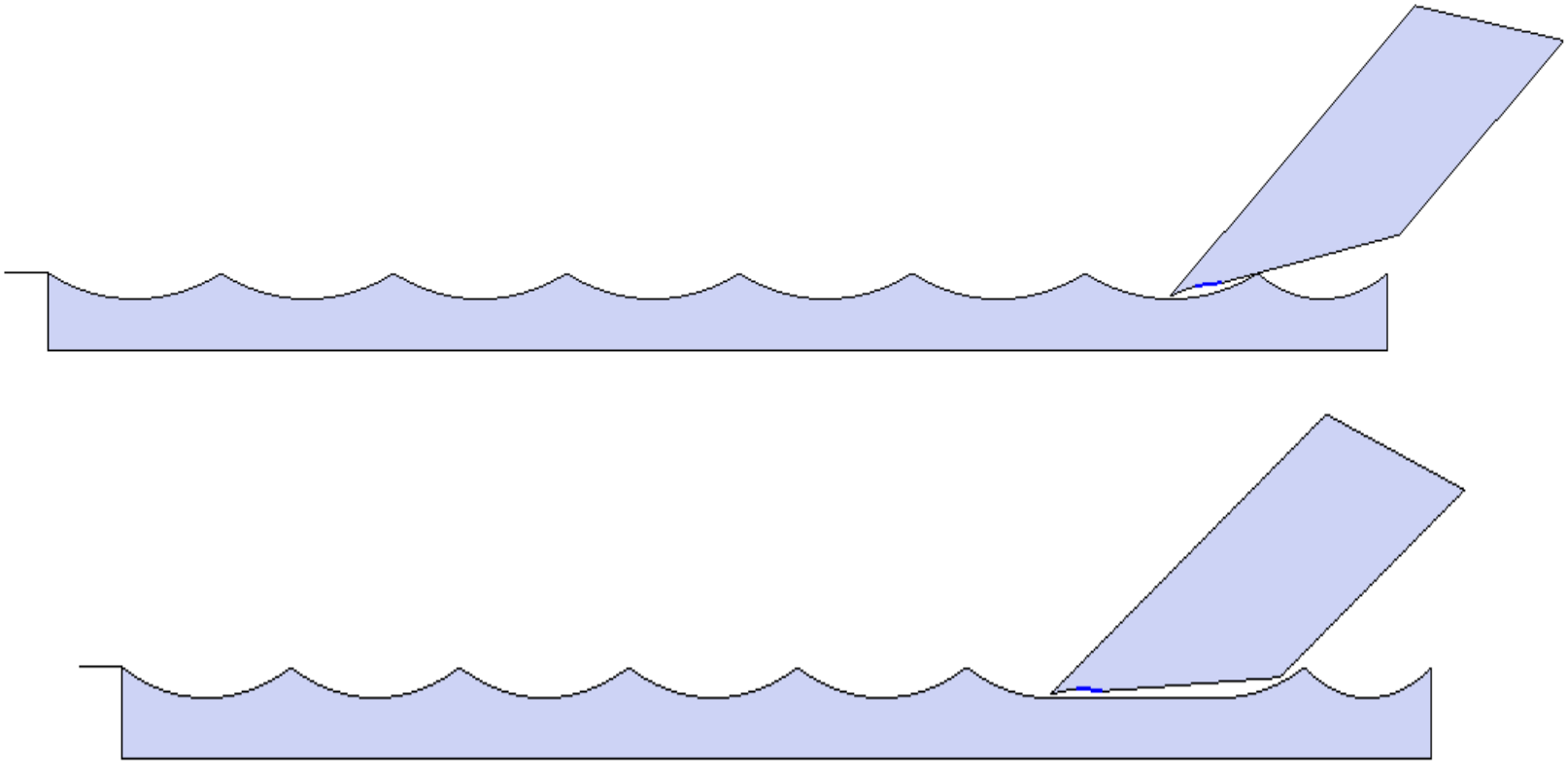




Grind a micro bevel (clearance) on the gouge



By reducing the bevel length , it allows the gouge to cut straight



And ride along the surface cutting straight & smooth without bouncing