

Tool Geometry And the Cutting Edge

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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.

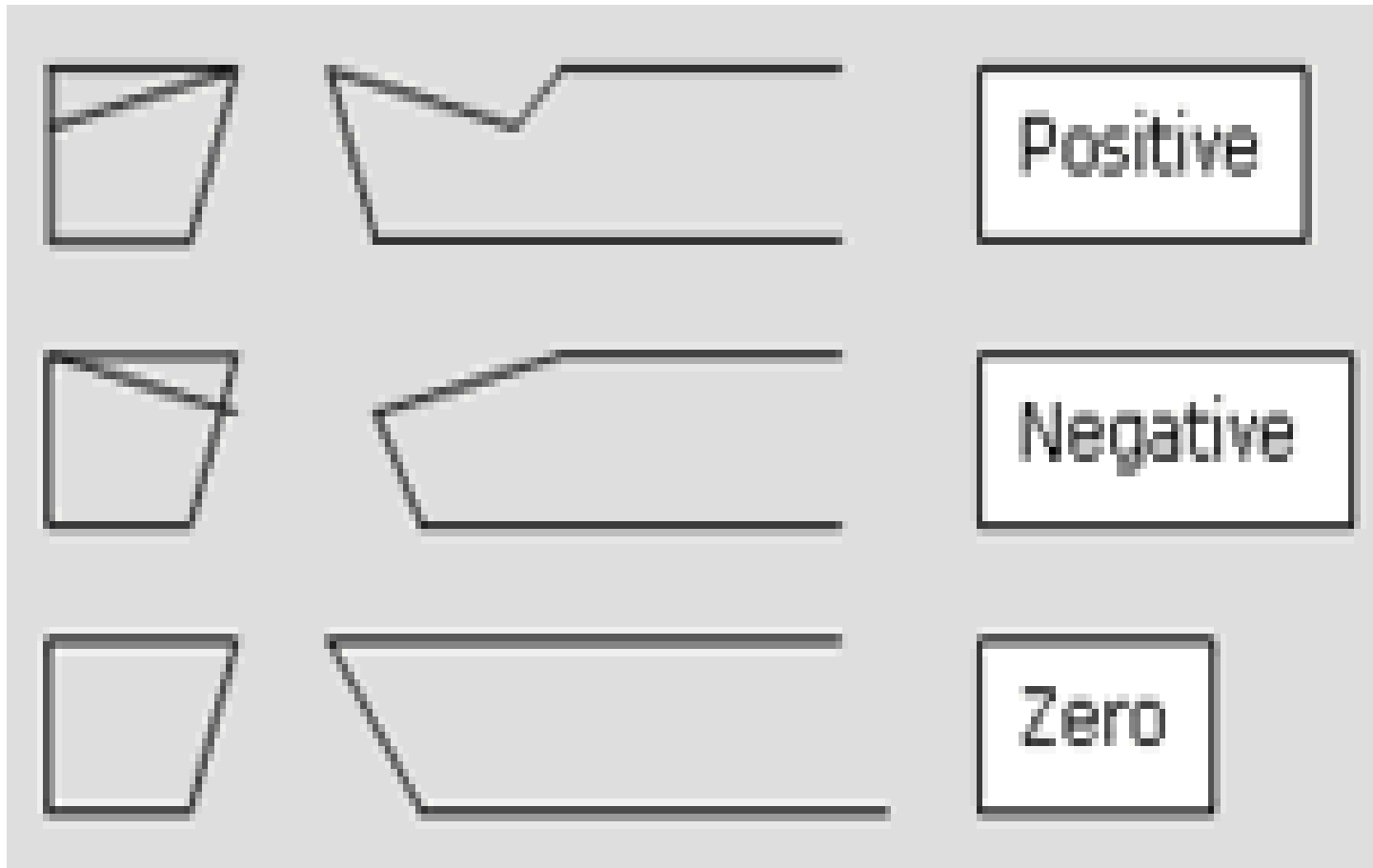
Number one rule:
Rub the bevel!

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

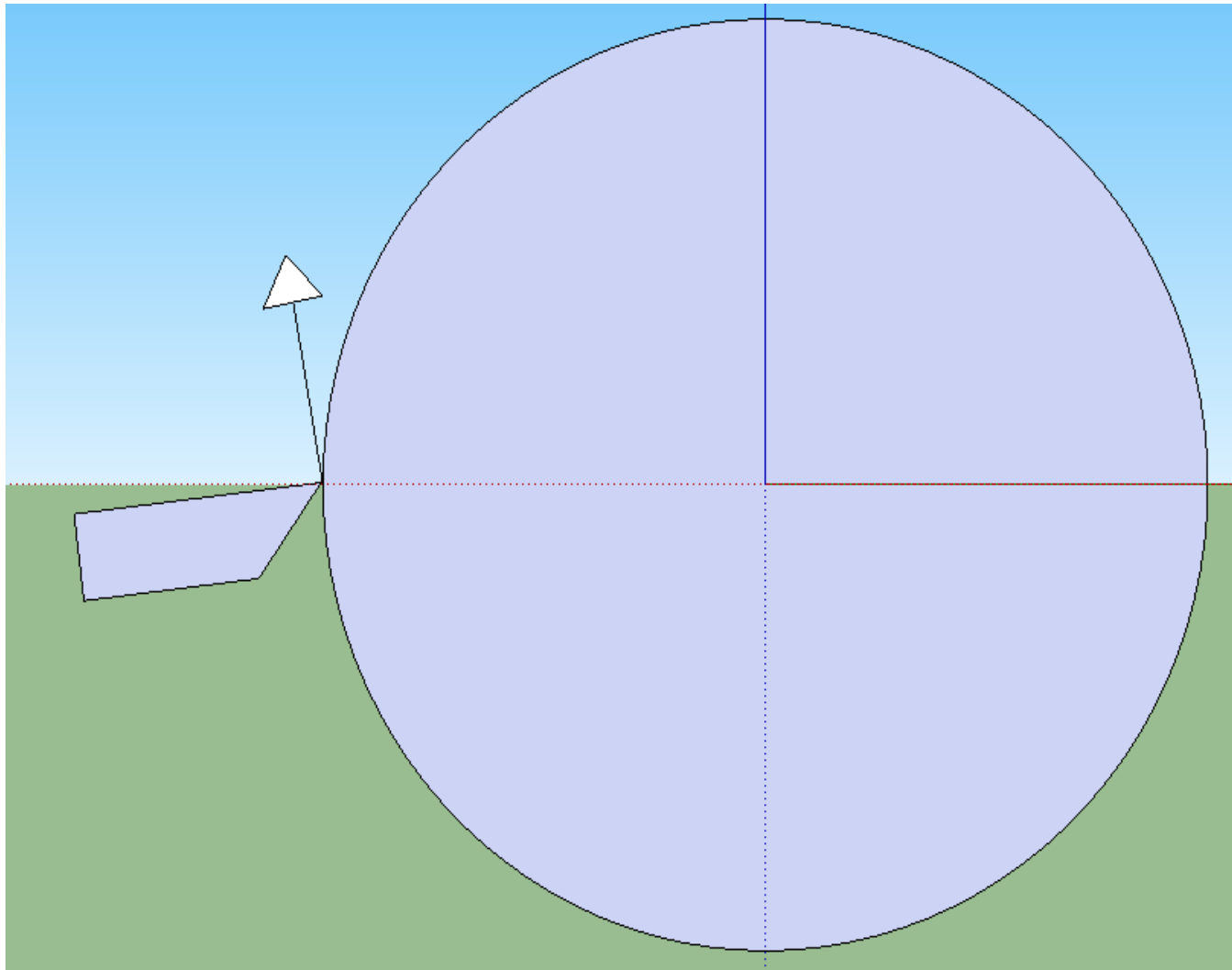
Number two rule:

Take very thin cuts with a sharp tool! Don't hurry. Take your time and do it right.

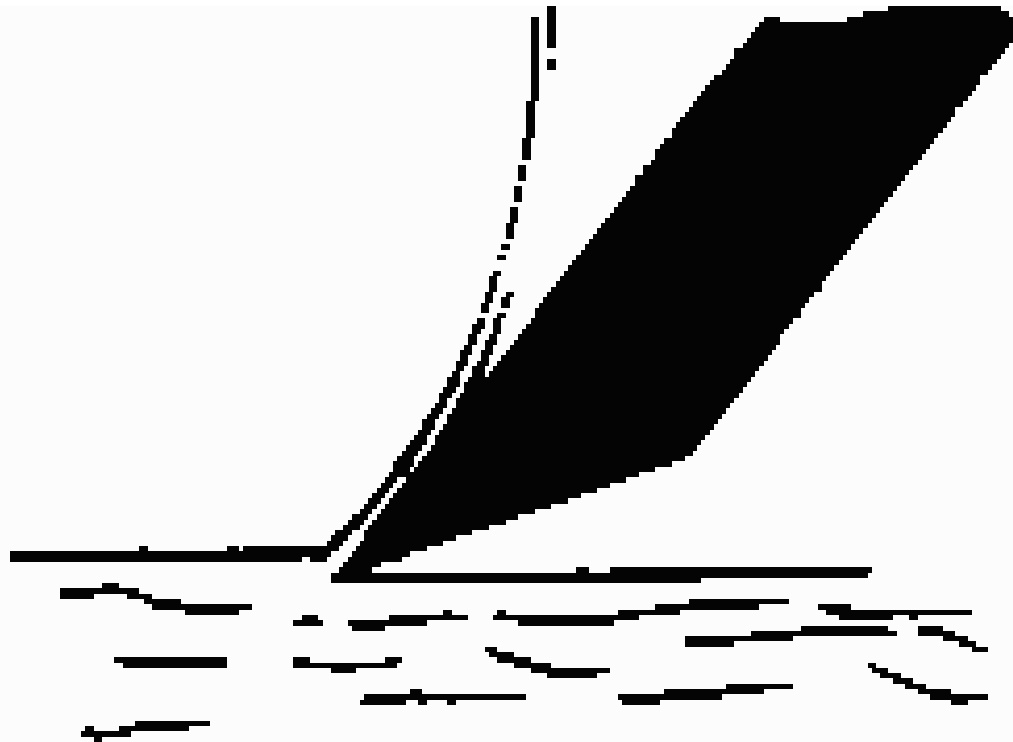
There are Three Types of Cutting Angles: Positive, Negative, and Neutral/zero



Positive Rake Tool



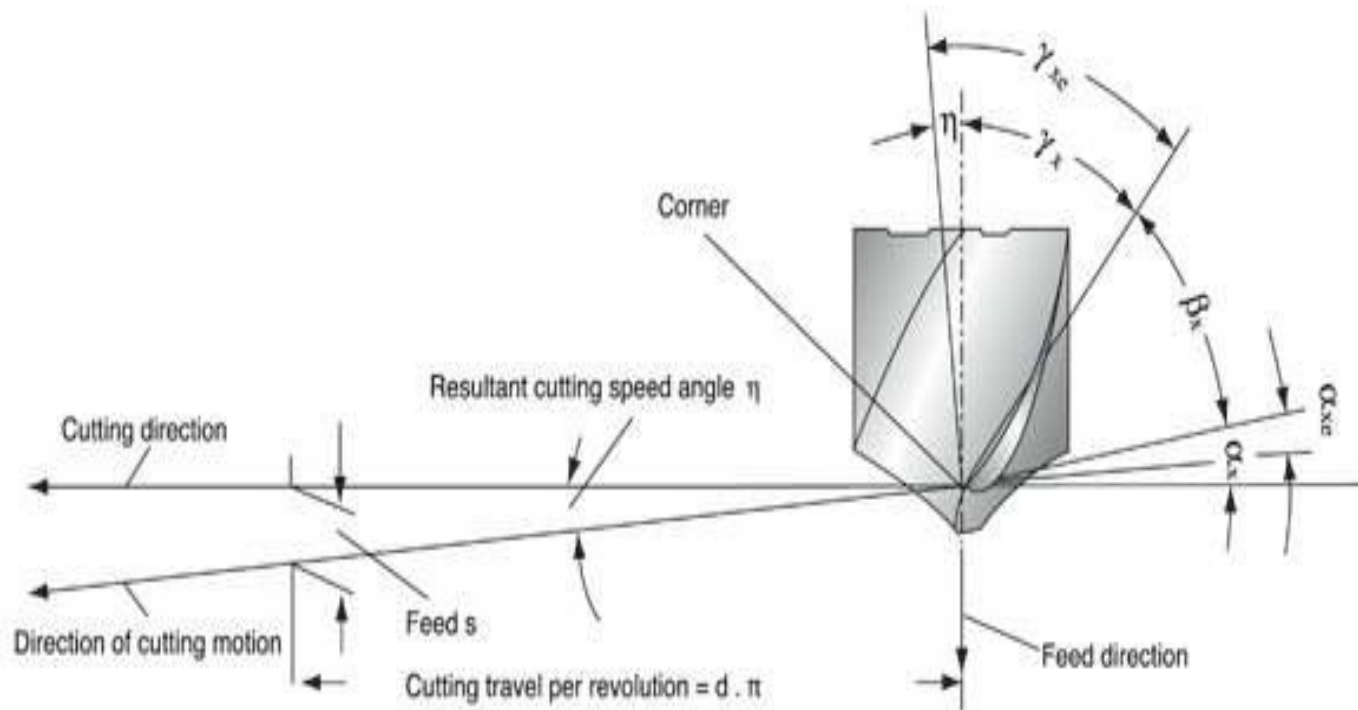
A Positive Rake Tool Lifts/Pulls the Wood Fibers Up



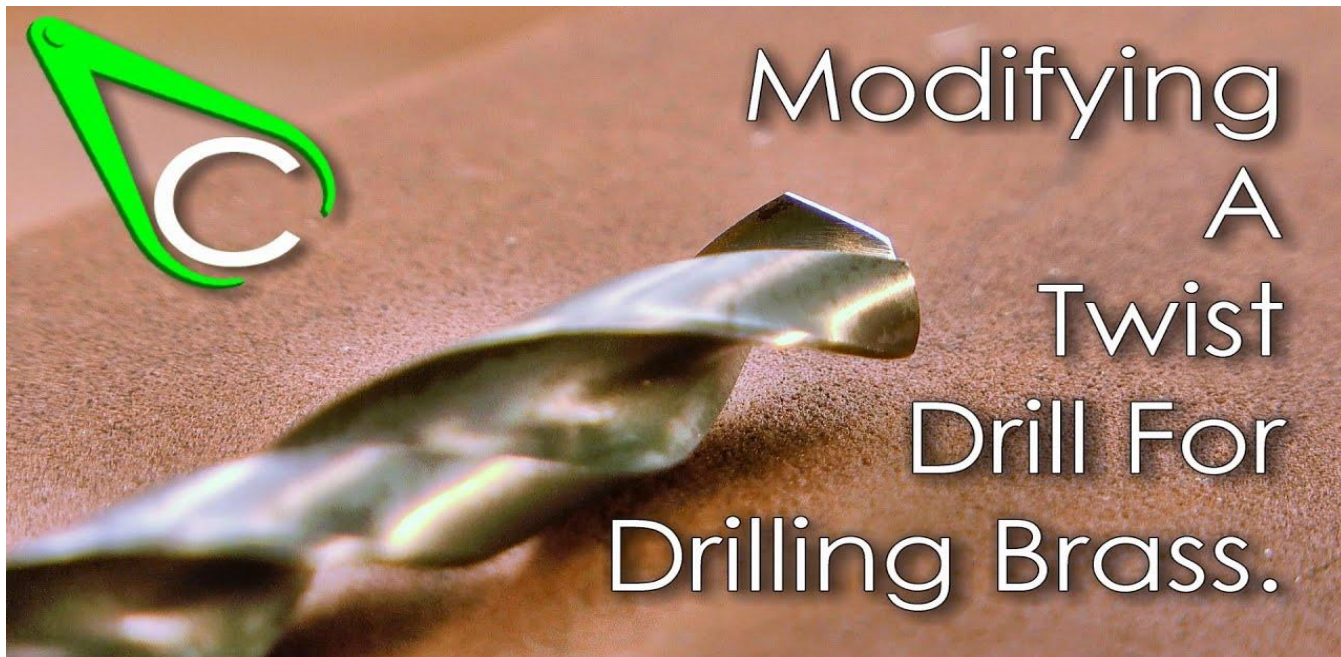
The common belief of the twist on a drill bit is for chip removal, which it does do,
BUT the twist gives the cutting edge a positive angle which helps PULL the drill bit into the work piece



γ_{xe} = Working front rake angle is the positive rake of the twist which helps the drill to “self feed”



If the cutting lip is ground flat, it turns the drill into a scraping action which is great for wood/brass/plastic, but, it kills the self feeding characteristic and makes it nearly impossible to drill steel

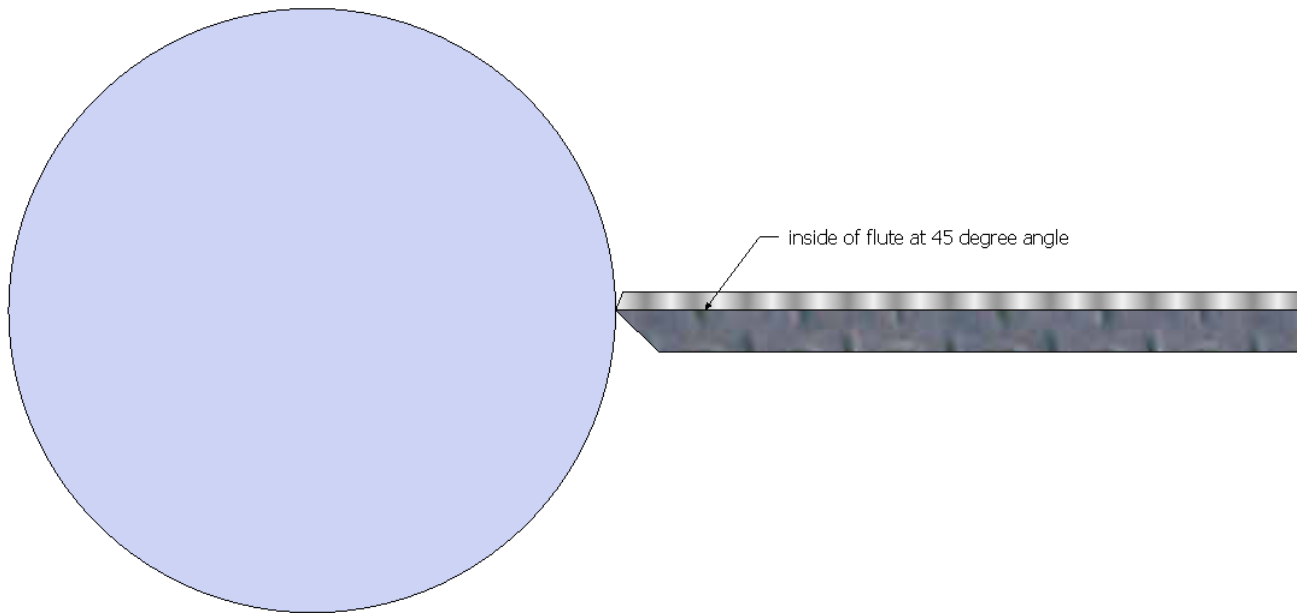


Changing the angle/twist of the gouge angle will give it more/less positive rake which can help reduce the force used to guide the through the cut in the work piece.

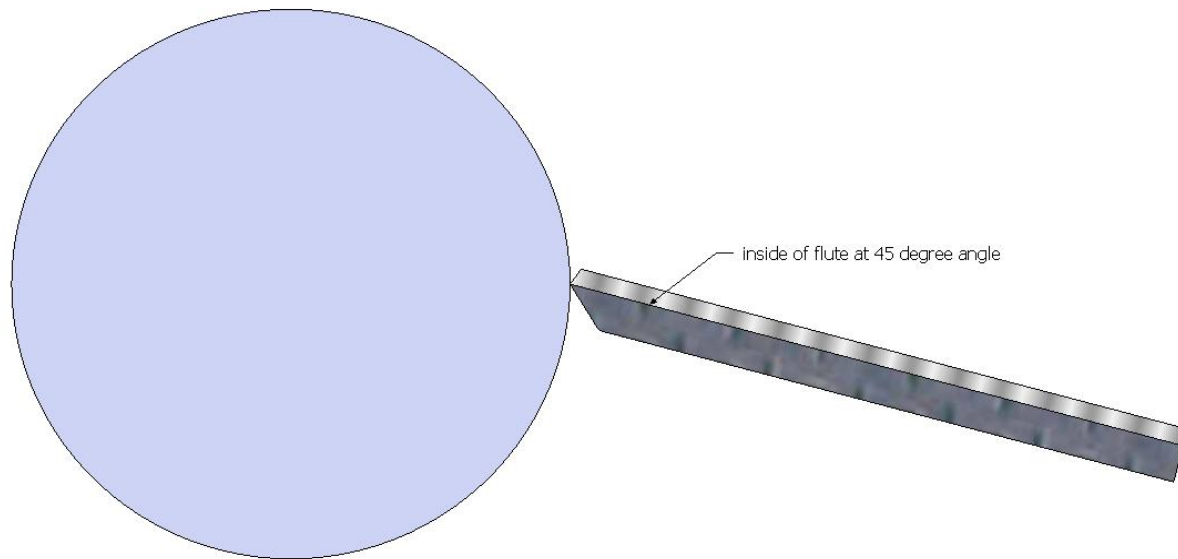
In other words, the positive angle can help pull the gouge into the work piece, reducing the force you apply to the tool making it easier to control.

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

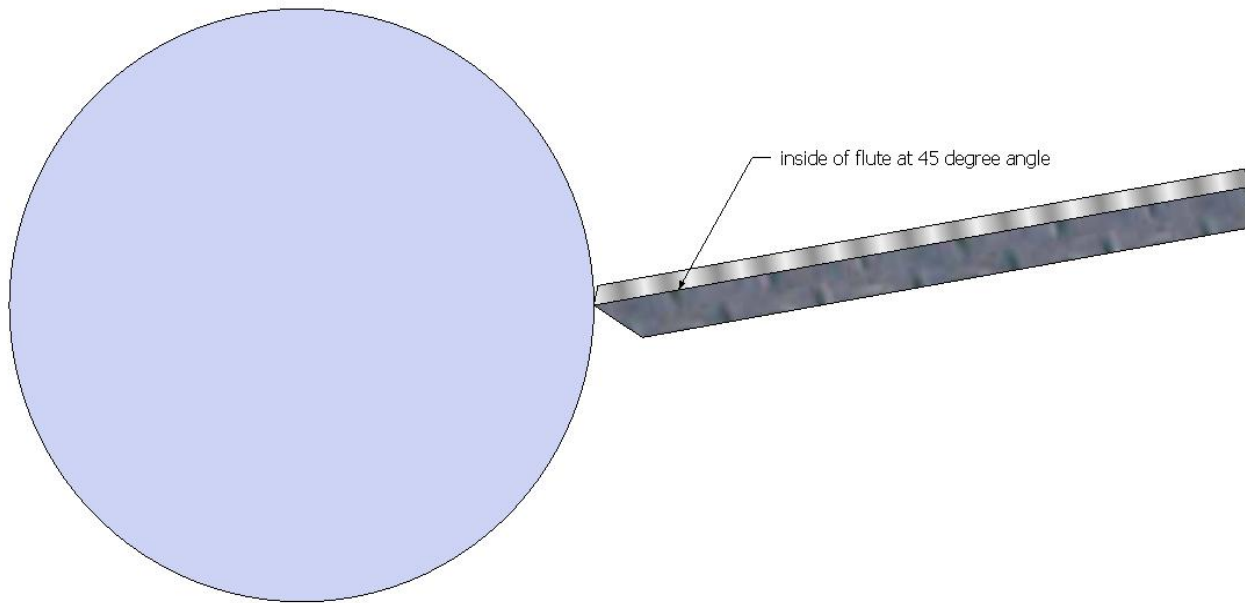
With the inside of the gouge flute parallel to the horizon (neutral/scraping rake) the flute is scraping the wood off.



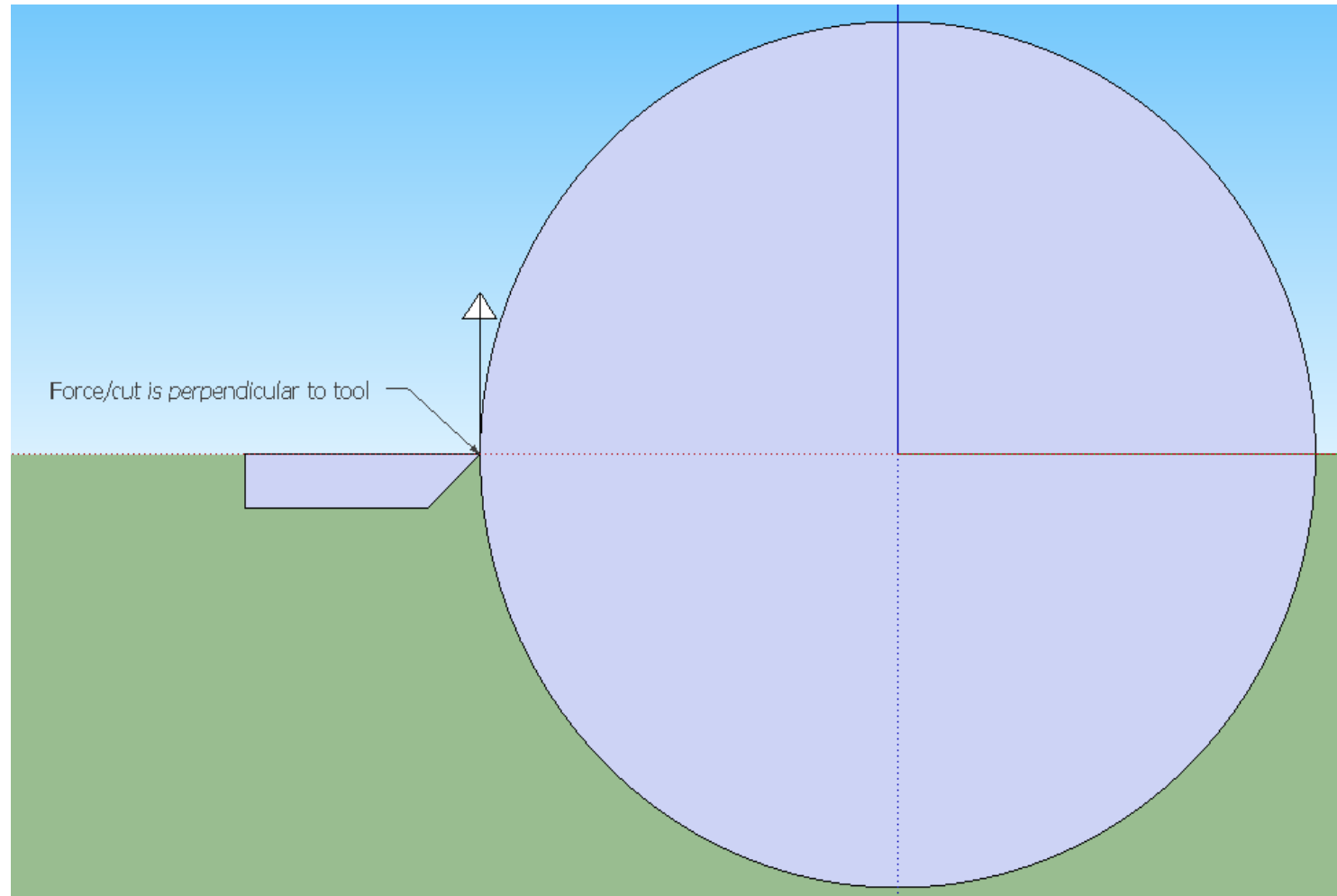
With the inside of the flute angled up (positive rake), the gouge will tend to self feed. If the angle is too great, it will cause the gouge to be “grabby” so then the angle should be reduced.



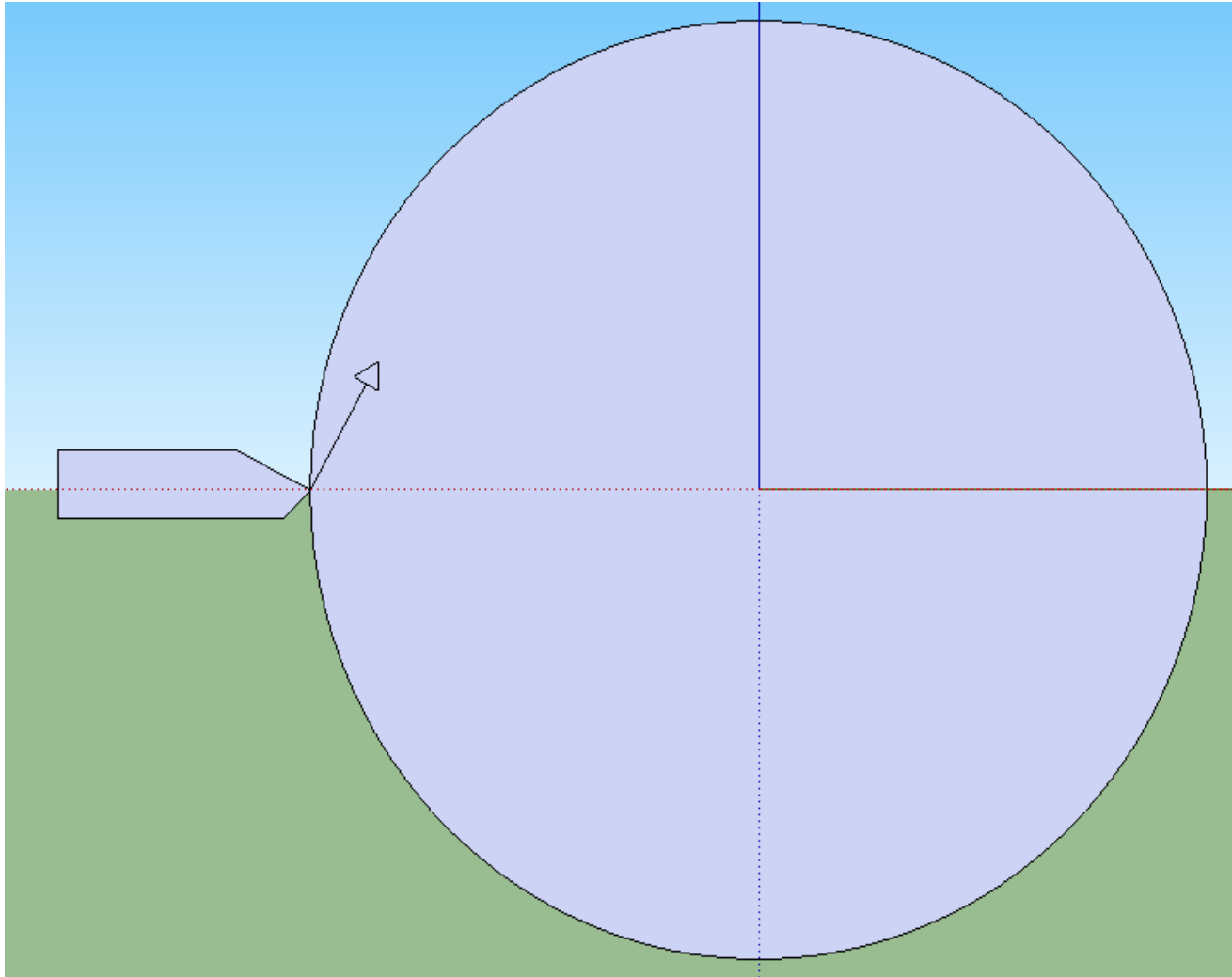
With the flute angled down, it will be a negative rake scraper and negative rakes don't want to cut. It will take more force to make this orientation cut.



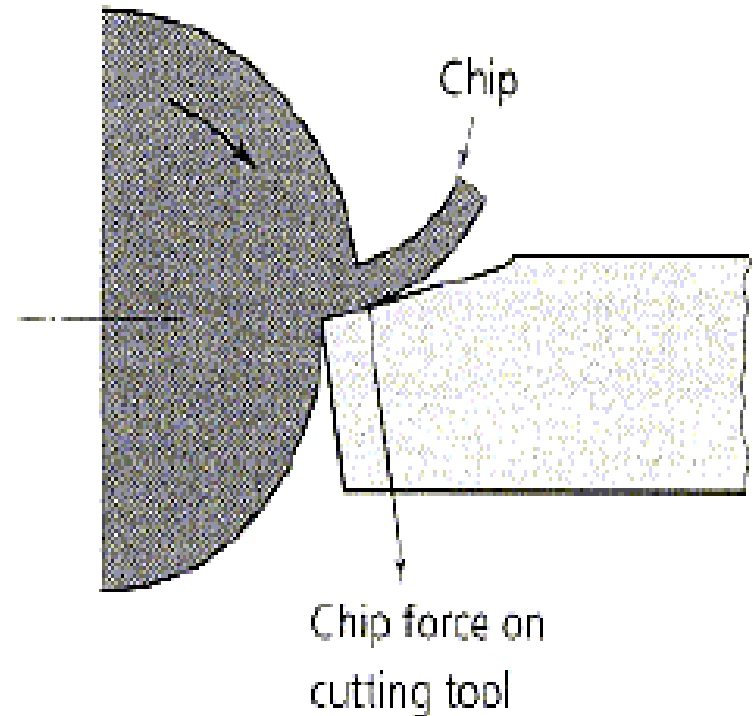
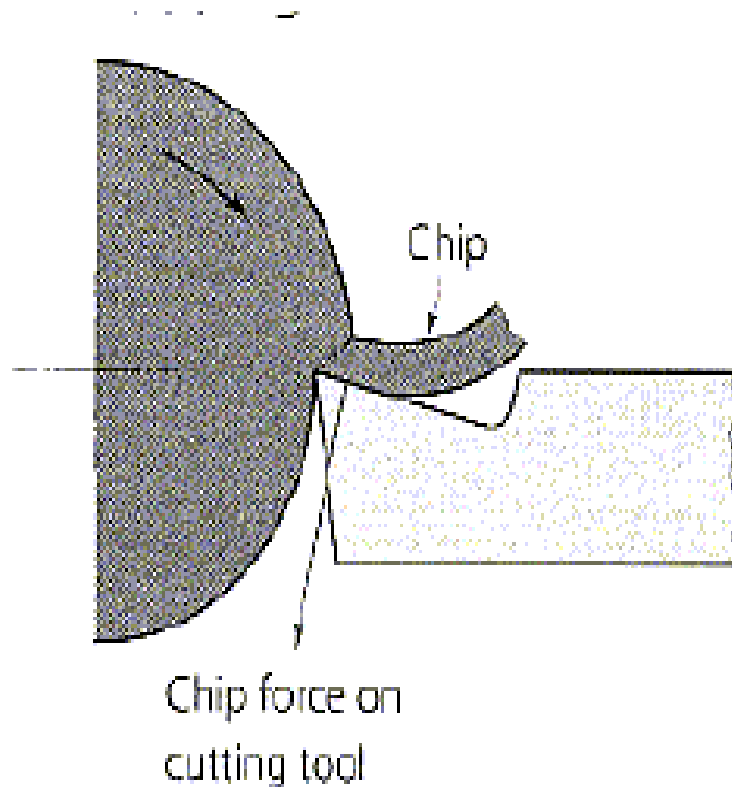
Neutral Rake Tool



Negative Rake Tool



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

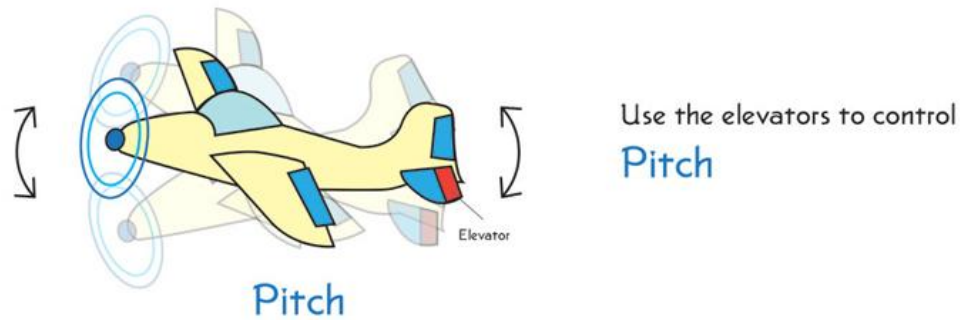
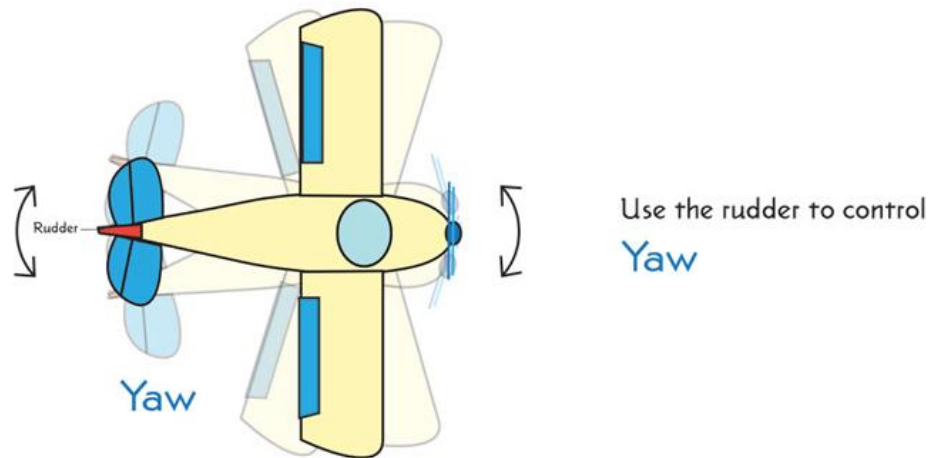
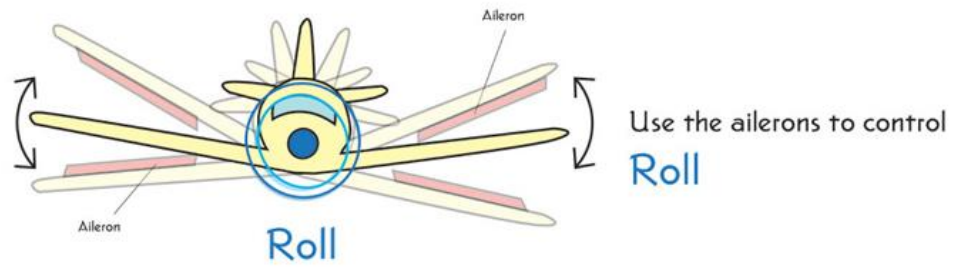


The negative rake tool actually pushes the wood fibers down and with that, the other wood fibers support the others so the fibers can be cleanly cut off.

So what angle/twist angle do you
hold the gouge when turning?
Simply put, it is not a static angle,
but it constantly changes
throughout the cut!

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



Simply put, there is no perfect angle because it can/will change throughout the cut as the grain direction changes from face grain to end grain/face grain!

I micro adjust the tool angles all through the cut.

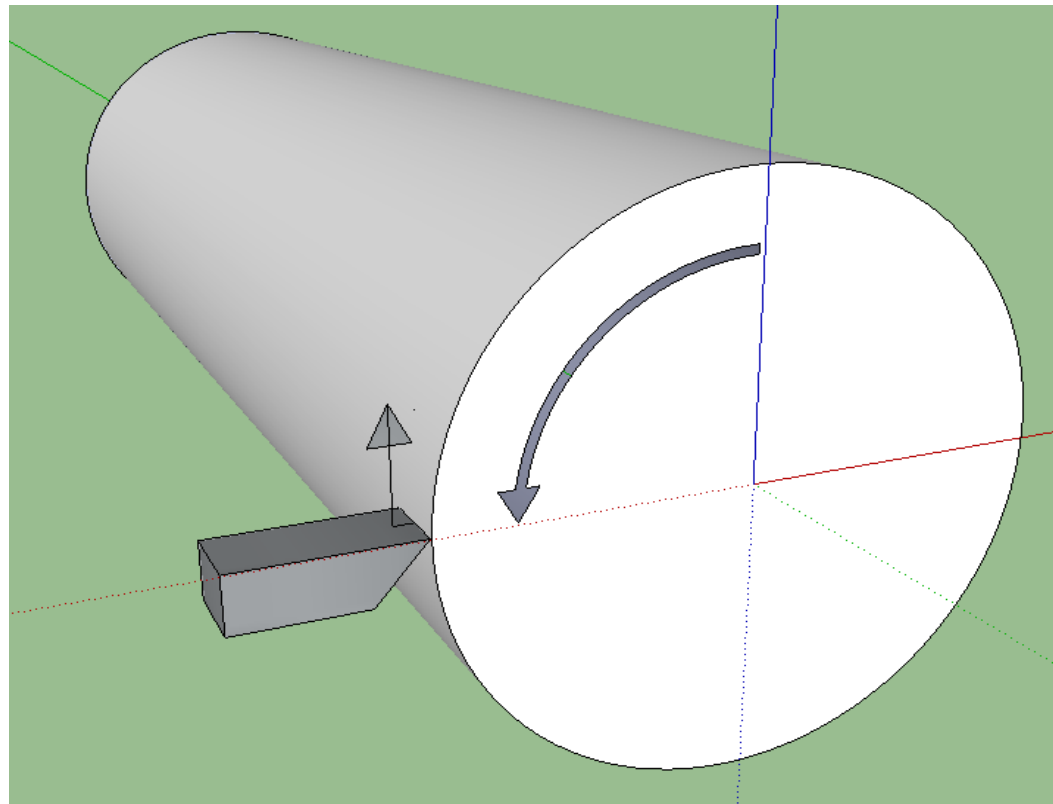
The Cutting Forces That We Are
Going to Discuss Are:

Scraping

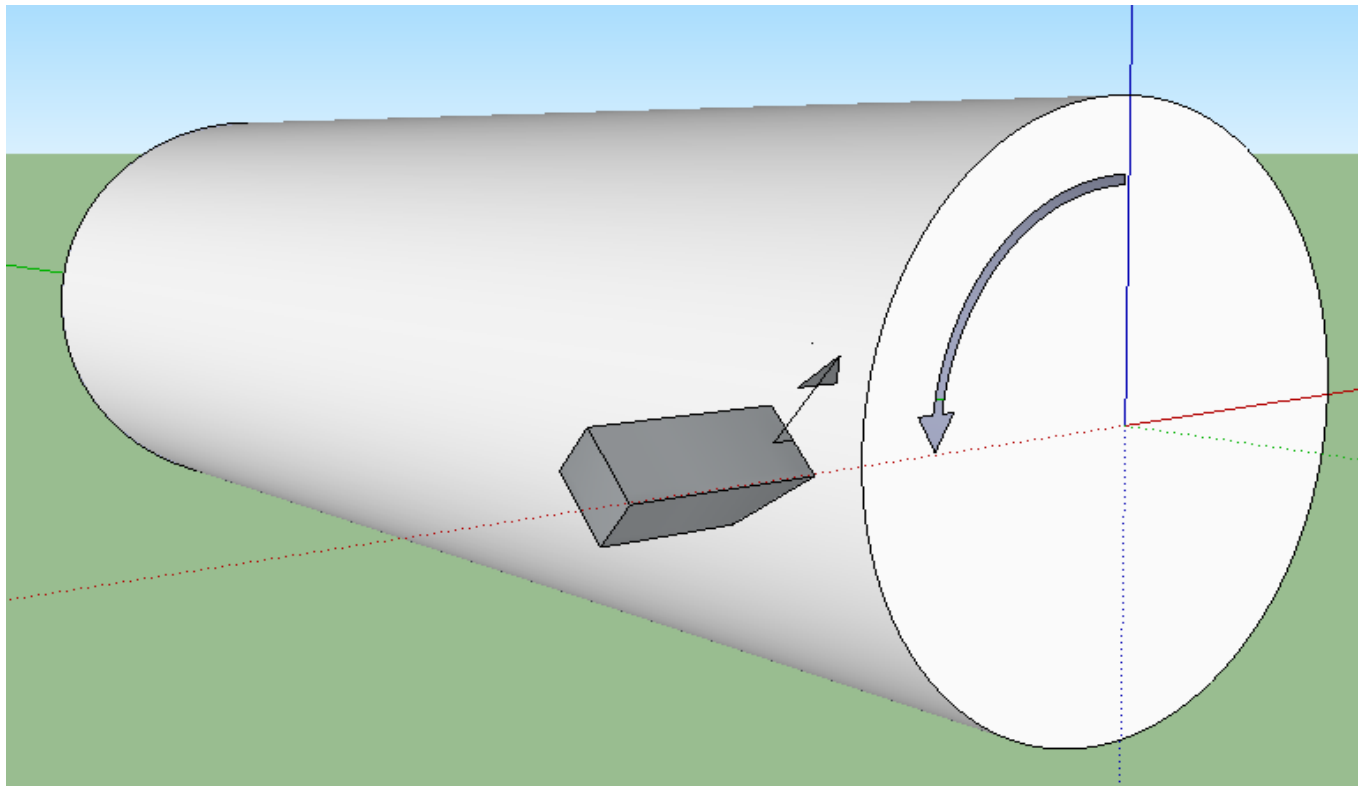
Shearing

Slicing

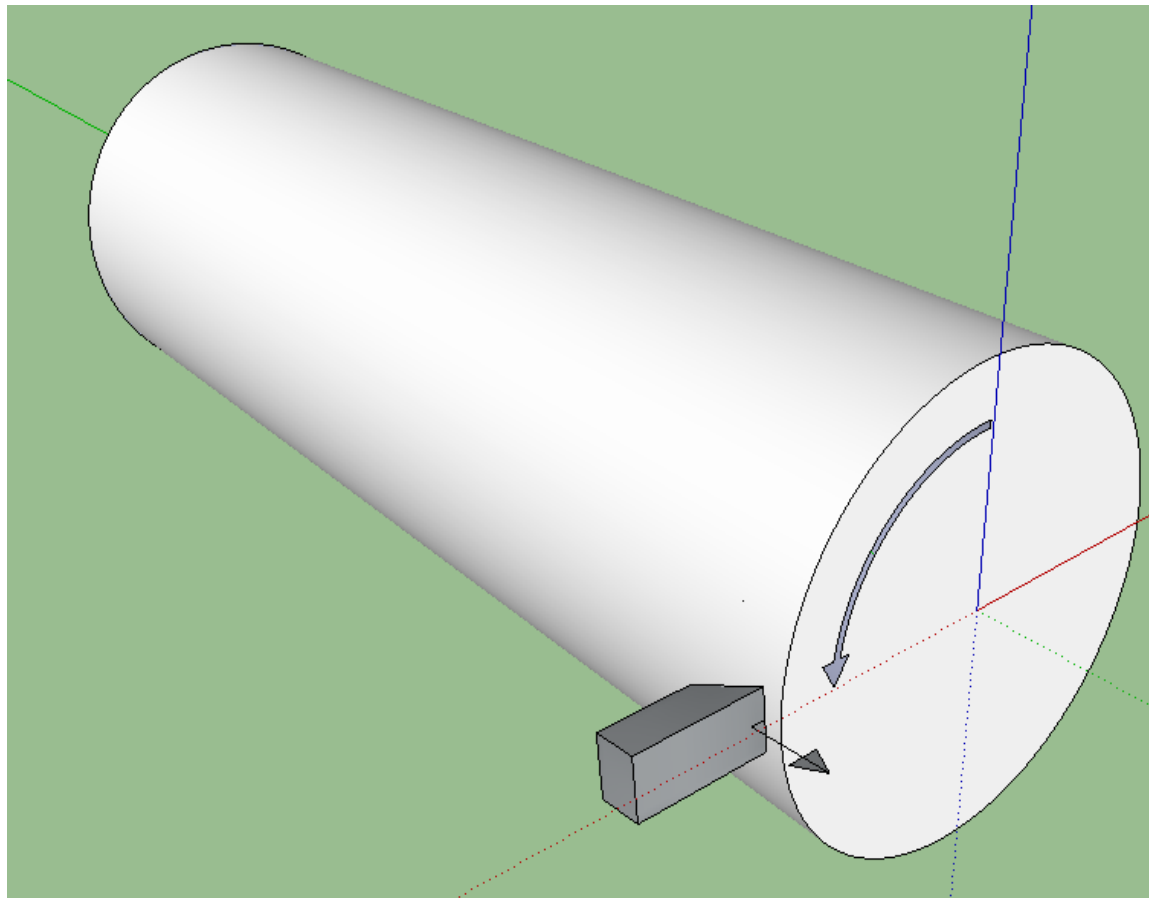
This is a scraping/neutral rake



This is an angled/shearing cut



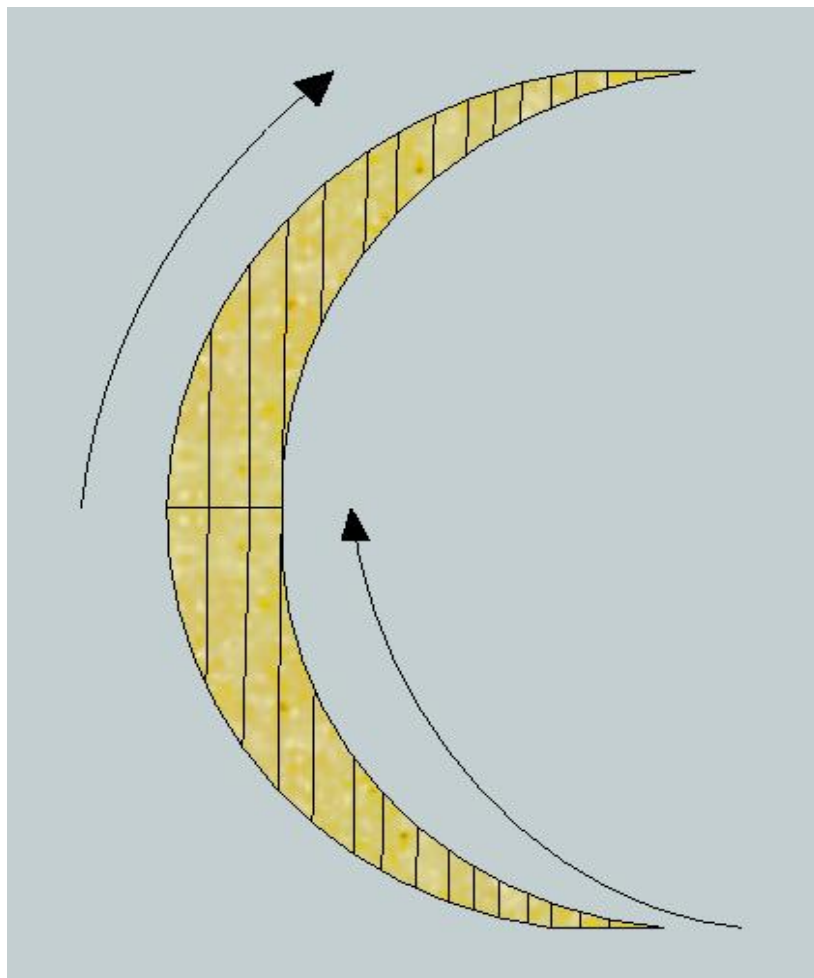
With the cutting edge nearly parallel to the rotation of the lathe, this is a slicing cut which cuts much cleaner



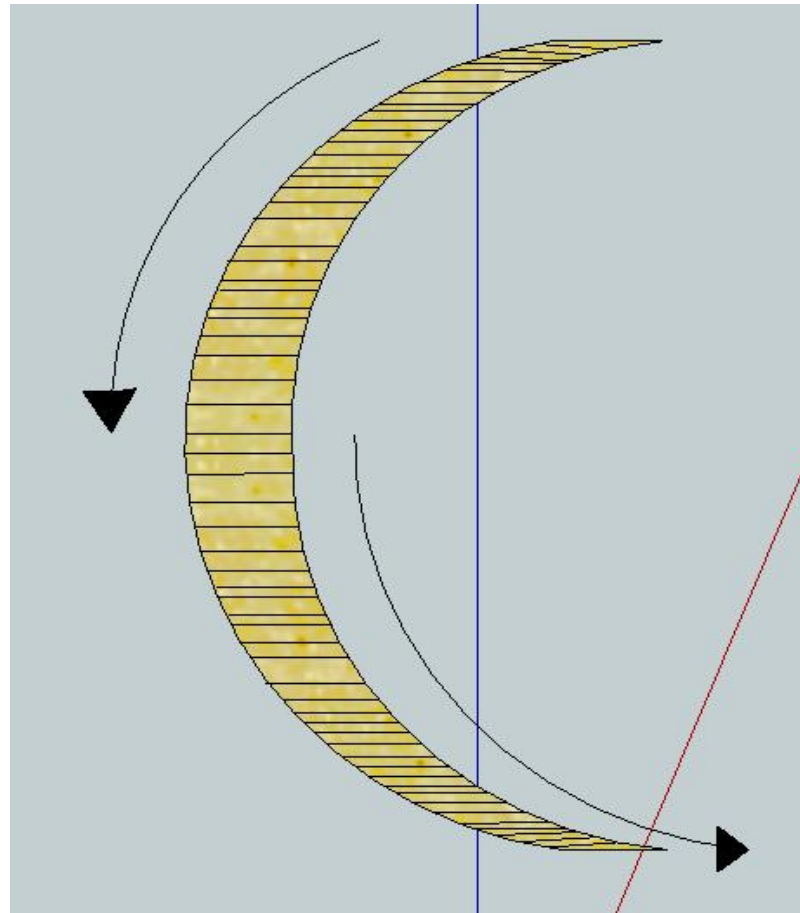
First, you have to consider the grain direction. You should always go WITH the grain, going against the grain causes tear out.

Always cut **WITH** the grain, not against the grain direction. Cutting against the grain direction will pull the wood fibers up like petting a dog backwards.

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



Slicing Cut: By closing the flute, the gouge will slice the side of the wood fibers with the nose radius instead of just shear cutting them. Notice that the cutting edge is almost parallel to the rotation of the wood.

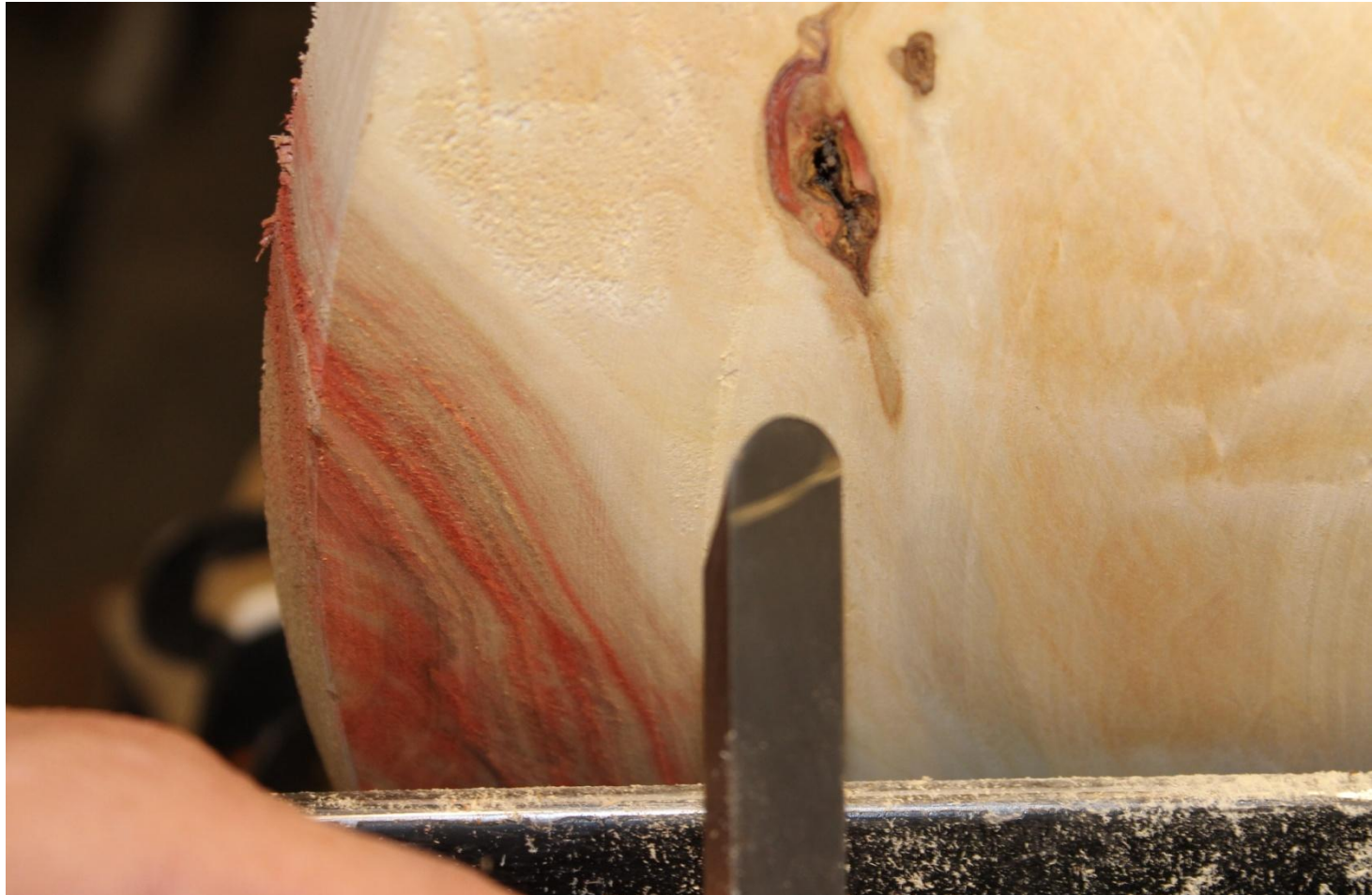


After finish turning with the nose radius in the closed position. The tear out is gone!



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 flute-less bowl gouge, rubbing
the bevel



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!

