



# Design for CNC Milling / Routing

Design for Manufacturing

# Limitations of CNC Milling

- Size of your material
- Inside corners - tools are round so you cannot get sharp inside corners
- Fixturing - clamping down your workpiece can be tricky
- Tool access



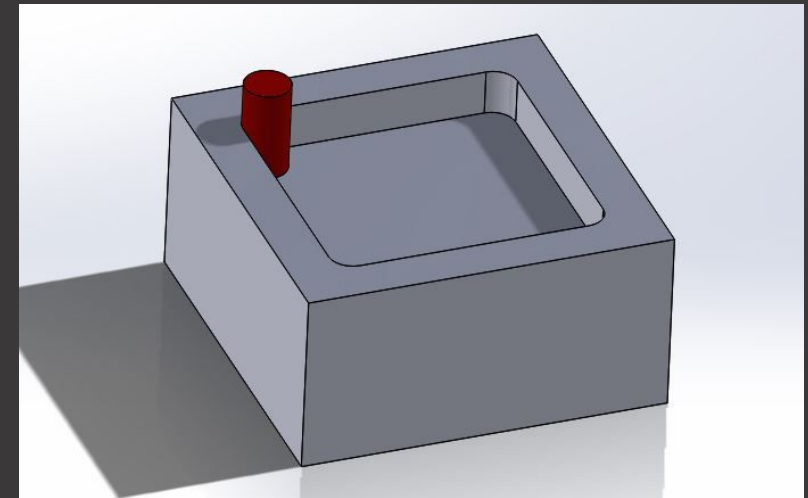
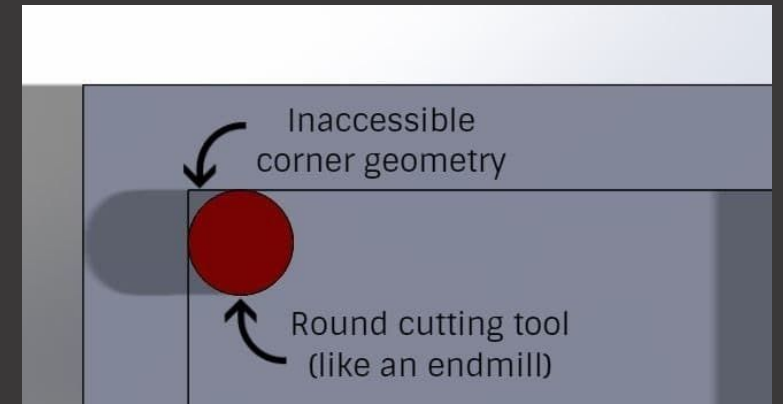
# Size of Stock

- CNC routers are typically used to cut flat sheet material
- Most common wood thicknesses that we use in the space are  $\frac{1}{2}$ " thick or  $\frac{3}{4}$ " thick
  - It is important to design your part with the size of your stock in mind, not choose it afterwards
- If you want something larger or taller then you will have to design it in parts

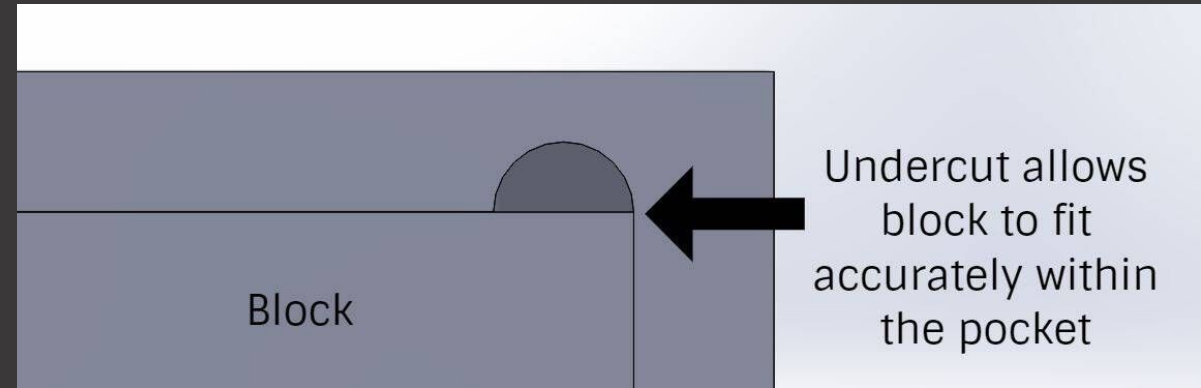


# Inside corners

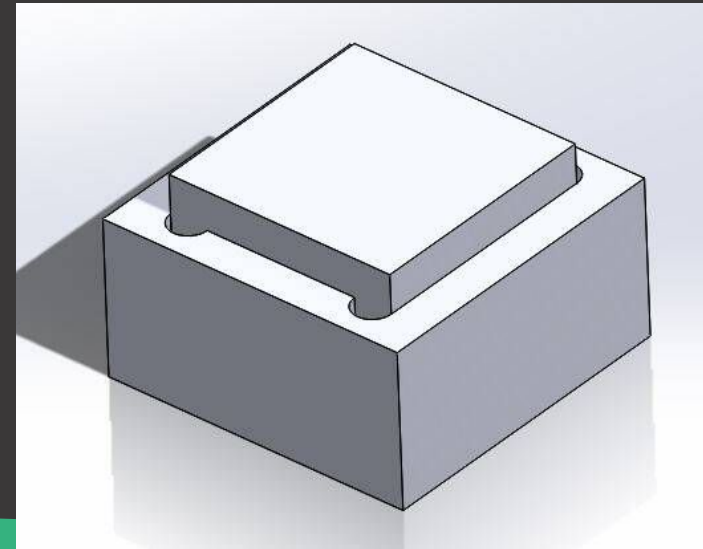
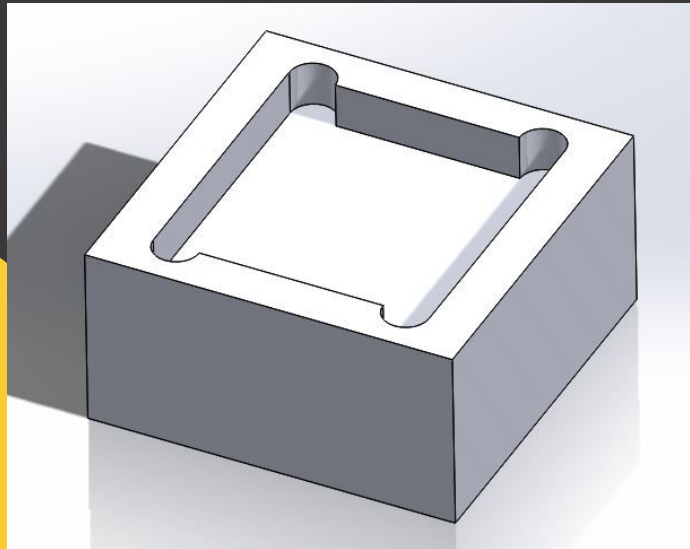
- Round cutting tools make it impossible to cut inside corners on a mill
- Unless you truly need that inside sharp corner, adding a radius is typically the answer
- If you need that inside radius because another part will fit inside there are several solutions



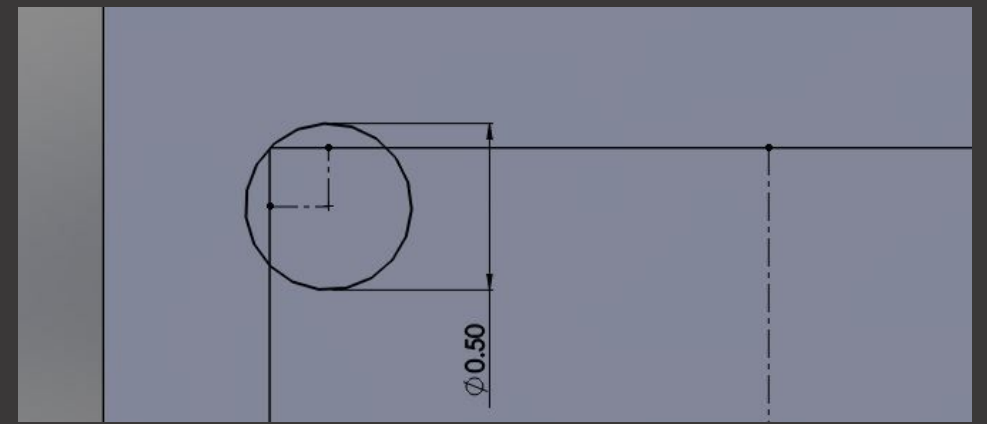
# Inside corners - One Sided Undercut



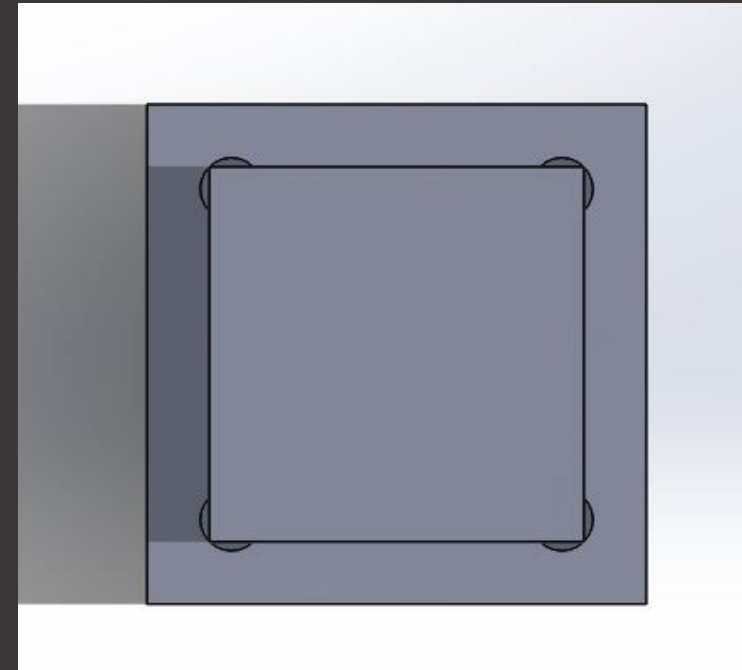
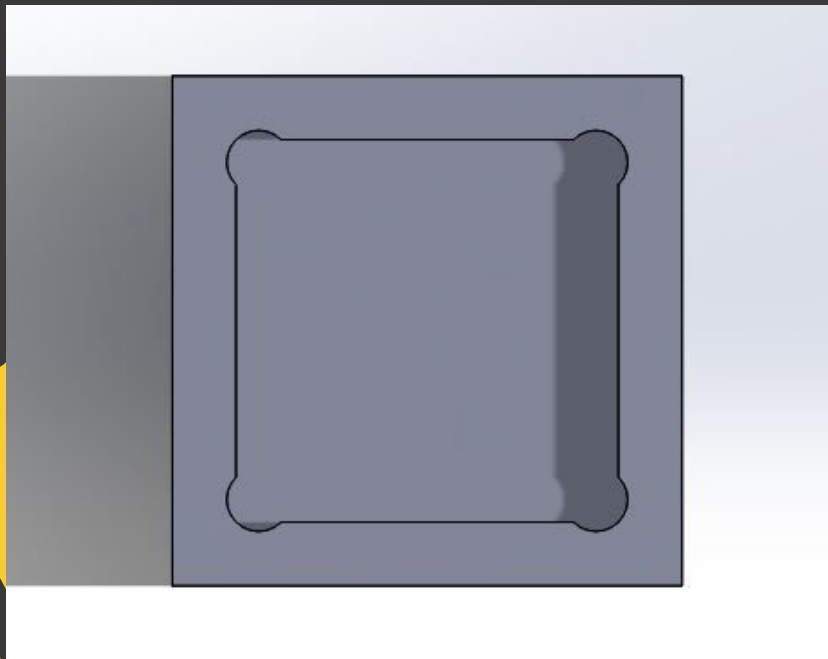
- The one sided undercut (dogbone) is the simplest way to clear out that material
  - Easy for manual machines because no extra calculations are required



# Inside corners - Two Sided Undercut

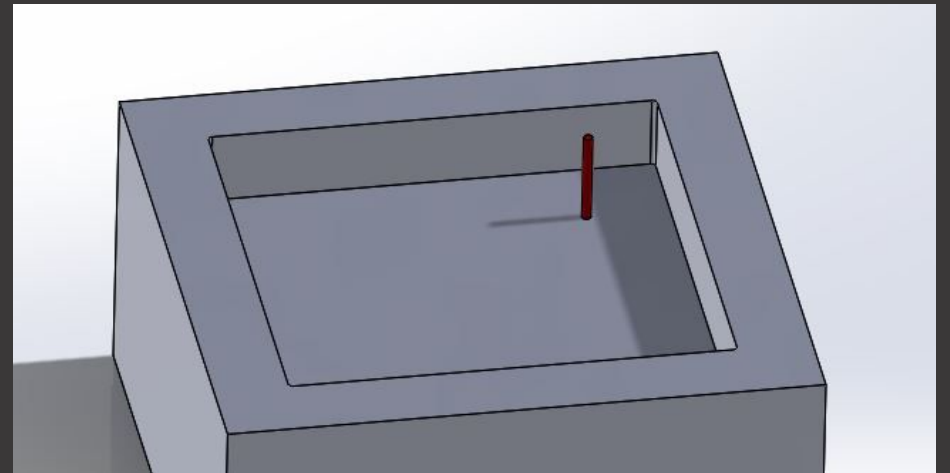


- The two sided undercut removes the least amount of material and produces a stronger corner
  - Harder for manual machines but for CNC machines it is easy



# Inside corners - Smaller tools

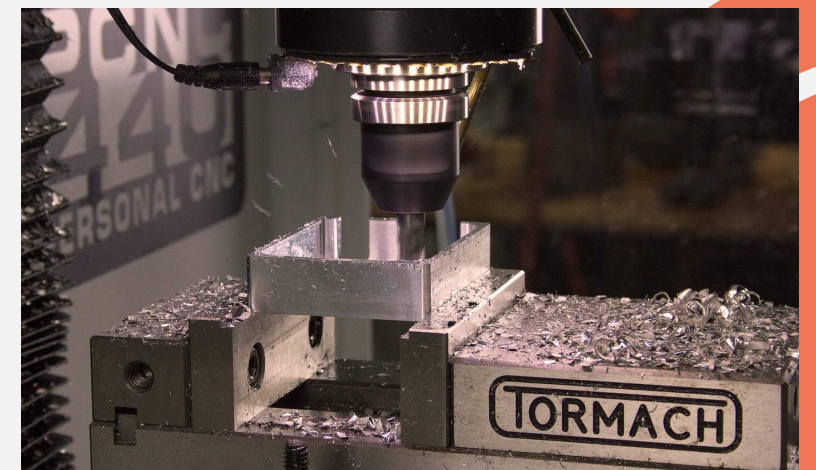
- While smaller tools may be an option to reduce that inner radius, it has drawbacks
  - Smaller tools are harder to machine with and break easily
  - It will take more time to remove that material





# Fixturing

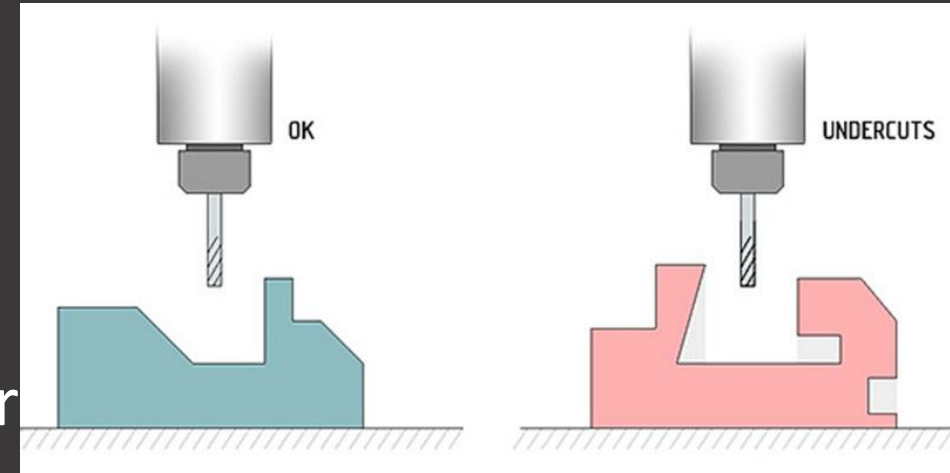
- How do you keep your piece tightly held down?
- Clamp in the rotary axis - easy and allows for double sided parts
- For 3 axis machining (x,y,z) on a router
  - Double sided tape - don't need tabs
  - Screws
  - Vacuum table
- For 3 axis machining (x,y,z) milling metal
  - Vise
  - T-slot clamps





# Tool Access

- In 3-axis machining you are limited to where the tool can reach - i.e. top down
- A rotary axis gives you a fourth axis which allows you to reach several additional spots
- Most undercuts are impossible without special tools



a 5-axis mill can cut more complex geometry

